X-RAY GENERATION

LIST OF DOCUMENTATION IN THIS BINDER:

- ⊗ SUBSYSTEM MANUAL OPTIMUS R/F
- ⊗ UNIT MANUAL Converter R/F
- ◯ UNIT MANUAL Extension set for an additional tube assembly WG/GWB
- ◯ UNIT MANUAL 26 V DC / 230 V AC Adapter
- ◯ UNIT MANUAL Handswitch for OPTIMUS
- ◯ UNIT MANUAL Extension Photomultiplier (SEV)
- ◯ UNIT MANUAL Mains group EWD
- ◯ UNIT MANUAL Power Distribution Unit (PDU)

Note: ⊗ indicated document present

LIST OF ALL BINDERS FOR X-RAY GENERATION:

- SUBSYSTEM MANUAL OPTIMUS R/F (this binder)

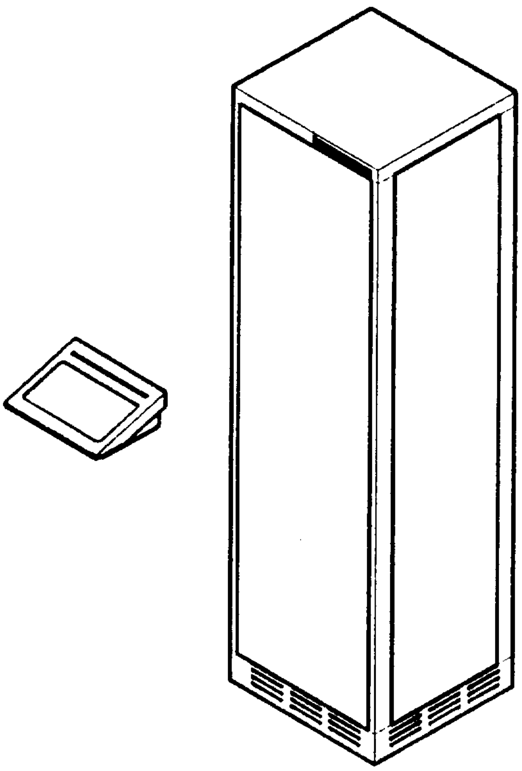
PHILIPS

Philips Medical Systems DMC GmbH

SERVICE MANUAL
742
SUBSYSTEM

OPTIMUS R/F

9890 000 02182



358J92

CAN-controlled X-ray generator of the converter type

DMC Hamburg

Printed in Hamburg, Germany

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SERVICE MANUAL – SUBSYSTEM

OPTIMUS R/F

Author: U. Wente

Type No: 9890 000 02182
Techn. No: Basis 4512 104 70625

Release: 3.5

In case there are any questions concerning this manual,
please send this LOPAD via fax to 49/(0)40/5078 2481

File: OPTIMUS_RF_25672_AA

List of pages and drawings (LOPAD)

Manual Order No: 4512 984 25672
released: 09/2002

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(nur für Fabrik–Auslieferung)
Service software No:
- OMA : 4512 116 0220x
- OMB : 4512 116 0230x

INTRODUCTION AND TECHNICAL DATA

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1. Product information

The Optimus family of generators for radiography is based on computer-controlled converter technology.
The converter operates in the non-audible frequency range.

Applicable options are essentially achieved by releasing software modules using customized PAL ICs.
Control between the internal **F**unction **U**nits (FUs) and the external online equipment takes place by a CAN bus.

Safety-relevant signals are transferred directly on the so-called "Signal bus".

Units without any CAN interface are operated by the "Adapter for 4 auxiliary units WA" option.

1.1. Applications

- Radiography
- Tomography
- Fluoroscopy

1.2. Options

Component overview according to the commercial catalogue.

Only the versions in the current commercial catalogue can be ordered.

If an existing generator is to be upgraded the commercial department must order:

MGR0011 (upgrade of an existing configuration)
\+ MGRxxxx
\+ S/N

1.2.1. Hardware options **+ MGR0011 + S/N**

- Dual-speed rotor control . . . . 9890 000 0268x MGR2082
- Mains transformer PDU: 400 – 480V; 50 / 60Hz,
  also for 400V mains supply without neutral lead N
  with taps for 400 / 440 / 460 / 480V 9890 000 0260x
- Mains transformer: 190–390V; 50 / 60Hz
  with taps for 190 / 200 / 207 / 220 / 230 / 240 / 250 /
  343 / 380 / 390V **max. 50kW!** 9803 720 8100x
- Adapter for 4 aux. units WA . . . . 9890 000 0231x MGR2131
- Adapter decade cable for 4 aux. units R/F WB 9890 000 0261x
- Option rack 9890 000 0232x
- Extension set for one additional tube 9890 000 0234x
- Tube extension WG 9890 000 0238x
- Operating panel 9890 000 0240x
- Operating module Optimus 9890 000 0278x
- Operating desk data cable 10m, 20m, 30m . . . . 9890 000 0241x / 2x / 3x
- Stand for operating panel . . . . 9890 000 0244x MGR1482

- Wall mounting of operating panel 9890 000 0245x
- 26VDC / 230VAC adapter .... 9890 000 0246x MGR2281
- Handswitch for Optimus 9890 000 0249x
- **P**atient **D**ata **O**rganizer (PDO) .... 9890 000 0255x MGR2091
- Decade cable set 14 x 4m top decade → AMP decade 9803 704 2010x
- Extension photo pick-up Optimus 9890 000 0258x

1.2.2. Software options + MGR0011 + S/N

Software options are provided by the function key (see also 5Z–1, EZ 139 Central Unit D38).
Additional hardware components are not required.

- **A**utomatic **E**xposure **C**ontrol (**AEC**) .... 9890 000 0281x [1)] MGR2171
- **A**natomic **P**rogrammed **R**adiography / **F**luorography (**APR**/**F**) .... 9890 000 0282x [1)] MGR2181
- Automatic **T**omo **T**ime **I**nput (**TTI**) .... 9890 000 0222x MGR2121
- **T**omo **D**ensity **C**ontrol (**TDC**) .... 9890 000 0223x MGR2122
- VARIOFOCUS .... 9890 000 0227x MGR2101
- Area dose calculator .... 9890 000 0256x MGR2141

1) = Options only for base 9890 000 0218x
Options are always included in base 9890 000 0216x

2. Compatibility

2.1. Generator components

- Base OPTIMUS 9890 000 0218x
- H.V. transformer R/F . . 1 tube, 50kW 9890 000 0270x
- H.V. transformer R/F . . 2 tubes, 50kW . . . . 9890 000 0271x . . . . MGR2061 (Upgrade 1 --> 2) tubes
- H.V. transformer R/F . . 1 tube, 65 / 80kW 9890 000 0272x
- H.V. transformer R/F . . 2 tubes, 65 / 80kW . . . . . 9890 000 0273x . . . . MGR2062 (Upgrade 1 --> 2) tubes
- 50kW extension – R/F 9890 000 0274x
- 65kW extension – R/F 9890 000 0275x
- 80kW extension – R/F 9890 000 0276x
- Firmware Rel. 3.5 . . . . 9890 000 0251x

2.2. Tubes

Recommended standard tubes:
- RO 17 50
- SRO 25 50
- SRO 33 100

Further compatible tubes:
- RO 30
- RO 12 30
- RO 16 48
- RO 30 50
- SRO 09 51
- SRO 13 30
- SRO 20 50
- SRO 20 55
- SRO 22 50
- SRO 32 100

Compatible tube housings:
- ROT 350
- ROT 351

The latest information on further tubes which are connectable is available at the service center Hamburg.

Note
When the generator is retrofitted it is important to use the screened cable 3 x 1.31mm^2 *(0722 215 02054) as the stator cable.*
If necessary exchange the old stator cable.

3. Mechanical data

For installation dimensions and weights see drawings Z-1.1.

Transport data:

Case No.	Contents	Weights [kg]		Dimensions [cm]		
		net	gross	length	width	height
1	- Generator cabinet - Operating panel - Cables	178	226	210	82	84
2	1-tube version: 2-tube version: Contents: H.V. generator	73 88	100 115	77	67	80

4. Environmental data

The environmental data comply with to PMS standard UXW 13600.

4.1. Electrical environment

Class S0 - Dedicated mains supply, 3 phases and neutral. Thus single phase voltage is also available.

A low impedance, permanently installed connection, fed in by the step down transformer of the hospital to supply large systems like in MR, CT and X-ray departments is required.

Note
Use always a mains cable with 4 wires and concentric PE-shield, type NYCY.

4.2. Climatic conditions

Ambient temperature .... 10°C - 40°C
Relative humidity .... 15% - 90%; no condensation
Relative atmospheric pressure .... 70kPa - 110kPa

4.3. Emission

Heat dissipation .... max. 1200W; average per hour
Noise level, normal operation .... ≈ 46dBA
Noise level, maximum power operation .... ≈ 55dBA
EMC .... IEC 950

To avoid any possible annoying noise of the implemented fans it is advisable to install the generator cabinet outside the examination room.

5. Electrical data

5.1. Power data and mains conditions

	Voltage		
	50kW	**65kW**	**80kW**
Mains voltage	3 x 400V ±10% (≅ 415V $^{+6\%}$ / 380V $_{-5\%}$)		
	3 x 400 / 440 / 460V ±10% * 3 x 480V $^{+6\%}$ | $_{-10\%}$ * * = with external transformer PDU (option) The following connection cables are recommended: Input: 3 +1 x 10mm^2 (L1, L2, L3, PE) Output: 4 x 4mm^2 Generator supply 3 x 400V 4 + 1 x 4mm^2 Device supply 3 x 220V (option) 3 x 1,5mm^2 Switch control and temperature supervision		
	3 x 190 ... 343V ±10% ** ** = with external transformer; max. 50kW (option)		

	Frequency		
	50kW	**65kW**	**80kW**
Mains frequency	49 ... 61Hz		

Voltage		Max. mains current		
		50kW	**65kW**	**80kW**
Exposure:	400V	145A	190A	230A
	440V	135A	180A	215A
	460V	125A	170A	210A
	480V	120A	160A	205A
	190V	300A	–	–
Short-time power consumption [I x U x √3]		100kVA	132kVA	160kVA
Fluoro:	400V	–	8A	
	480V	–	7A	
Fuse protection (slow blow)		35A	50A	
		100A at ≤ 240V	–	
Connected load [I_{Fuse} x U x √3]		25kVA	35kVA	
Emergency power supply:				
	static (Inverter)	Short-time power consumption [I x U x √3]		
	dynamic (Diesel generator with flywheel mass)	Connected load [I_{Fuse} x U x √3]		

Voltage	Mains resistance		
	50kW	**65kW**	**80kW**
400V	≤ 300mΩ	≤ 200mΩ	
440V	≤ 350mΩ	≤ 240mΩ	
460V	≤ 350mΩ	≤ 240mΩ	
480V	≤ 400mΩ	≤ 300mΩ	
480V valid for DOD only	≤ 300mΩ	≤ 240mΩ	≤ 180mΩ
	Note *500mΩ is the **absolute max.** mains resistance.*		

5.2. Power supply for applications

Supply	Generator power 50kW	65kW	80kW
Output 1	230V / 400V; generator switched and protected --> I_1		
Output 2	230V / 400V; generator switched and protected --> I_2		
Output 3	230V / 400V; generator **not switched** and protected --> I_3		
	Sum value $I_{max\ (1+2+3)} \leq 10A$		
Only with external transformer PDU			
Output 4	127V / 220V generator switched and protected --> I_4		
Output 5	double socket 127V / 15A to phase L1; generator **not switched** and protected --> I_5		
	Sum value $I_{max\ (4+5)} \leq 16A$		

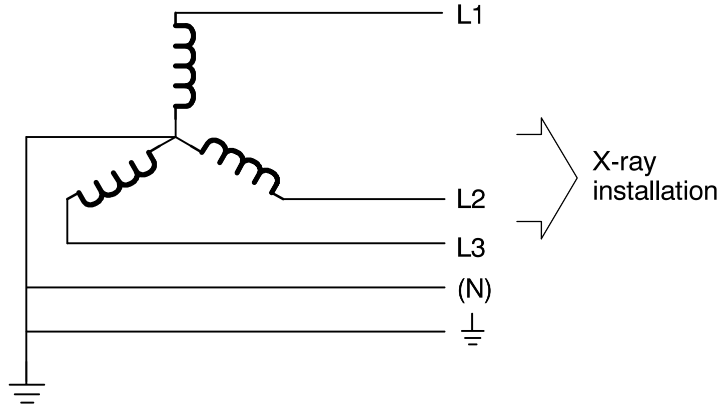
5.3. Operating data

Data	Generator power 50kW	65kW	80kW
Exposure: Tube current	1 ... 650mA	1 ... 900mA	1 ... 1100mA
Tube voltage	40 ... 150kV in kV- or %-steps		
mAs product	0,5 ... 850mAs		
Exposure time	1ms ... 6s / 16s		
Exposure frequency	≤ 12exp./s		
Interfacing option for	door contact, external radiation warning indicator		
Fluoro: Tube current	0,25 ... 6mA		
Tube voltage	40 ... 110kV		
kV/mA curves	3		
Setting time	≤ 1s		

5.4. Power supply

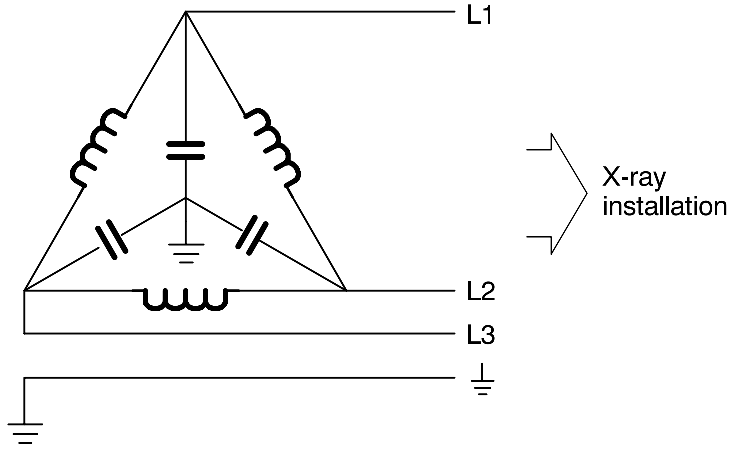
5.4.1. Type of power supply

3 phase WYE



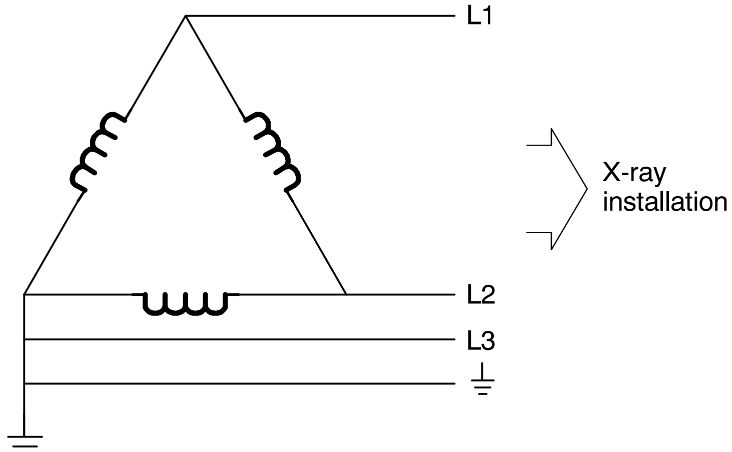
- 400V
- 440V / 460V / 480V with external mains transformer PDU 9890 000 0260x.
- Neutral not required if the external mains transformer PDU 9890 000 0260x is ordered.
- 190V ... 343V with external mains transformer 9803 720 8100x (max. 50kW).

3 phase DELTA, balanced earth or floating



- External mains transformer PDU 9890 000 0260x is required.
- 400V / 440V / 460V / 480V
- 190V ... 343V with external mains transformer 9803 720 8100x (max. 50kW).

3 phase DELTA, grounded



- External mains transformer PDU 9890 000 0260x is required (requires modification at the EMC-filter of the kV power unit).
- 400V / 440V / 460V / 480V

Caution!
Ensure the sequence of phases in the wall junction box corresponds to designations L1, L2, L3.

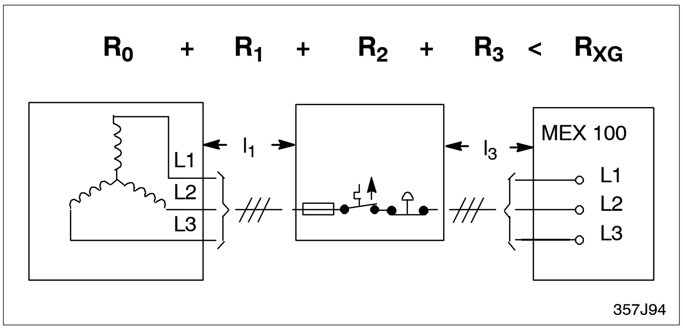
5.4.2. Calculating the mains resistances

Note

The cross section of lead l_3 must not exceed 25mm^2. (See figure below).

If possible the sum of R_0, R_1, R_2 and R_3 should be smaller than the R_{XG} requires.

With higher internal mains resistances the generator output is reduced correspondingly.



R_0 designates the mains resistance of the distributor transformer

R_1 depends on the length of lead l_1 between distributor transformer and mains distributor and on the selected cross section as well:

==> $R_1 = l_1 \times R_{Cu}$ R_{Cu} from table below

R_2 consists of upstream elements such as:

- Emergency-OFF switch 4.0mΩ
- Earth-leakage circuit breaker 5.5mΩ
- Fuse 5.5mΩ
- Surge arrester WN 23.0mΩ

R_3 depends on the length of lead l_3 between mains distributor and wall junction box and on the selected cross section as well:

==> $R_3 = l_3 \times R_{Cu}$ R_{Cu} from table below

The resistances consider the go and return lines so that the calculation can be based on simple cable lengths.

Copper cross section [mm^2]	**Resistance R_{Cu} [mΩ/m]**
16	2.19
25	1.4
35	1.0
50	0.7
70	0.5
95	0.38
120	0.30
150	0.24

Note

*500mΩ is the **absolute max.** mains resistance.*

5.4.3. Earth-leakage circuit breaker

To be provided between mains fuse and X-ray installation depending on local regulations.

Siemens earth-leakage circuit breaker:

- Order No.: 5SZ3 466 OKG00
- Rated fault current 30mA
- Rated current 63A
- Connection terminals for wire cross sections of up to 25mm^2

5.4.4. Emergency-OFF device

To be provided depending on local regulations.

There are 2 possibilities:

1. All the Emergency-OFF buttons are connected in series and looped into the switch-ON circuit (12VDC) of the generator.
2. The Emergency-OFF circuit acts on an external mains contactor which switches OFF the power before it is fed into the generator.

6. Tools

- Service engineer standard tool kit

- Service-PC:
  IBM-compatible, 640kB RAM, 3.5” floppy disk drive, ≥ 1 serial port

- Installation and service software OMA: 4512 116 022xx / OMB: 4512 116 023xx.
  Supplied on two floppy disks within this generator service manual.

- PC-hardkey (DIAGGEN):
  Necessary to carry out the installation and to run the service software (special programmings, fault finding).

- 0-modem cable:
  Minimum length is distance between generator cabinet and operating desk.
  Male 25-pole D-Sub connector at the generator side.
  A 5m data cable of bucky controller can be used: 4512 130 5693x

- Mains resistance measuring instrument

- Dose measuring instrument

- mAs-meter

- Multimeter

- Digital oscilloscope with 2-beam memory

- Recommended PLCC extraction tool (AMP 822154-1): 2422 487 89772

7. Traceable items

The following items have serial numbers of the following format when delivered ex factory:

1. Generator cabinet . . . . 6 digit serial number

2. H.V. tank . . . . 7 digit serial number

3. Operating desk . . . . 8 digit serial number

8. Preparation

Connection of the generator: . . . . see drawing Z-6.1
Connection of the generator with PDU: . . . . see drawing Z-6.2
Operating panel: . . . . see drawing Z-1.3
Connection diagram: . . . . see drawing Z-7.1/.2/.3/.4
Earthing diagram: . . . . see drawing Z-7.5
Legend for earthing and cabeling: . . . . see drawing Z-7.10

8.1. Installation material

To be ordered from the service department of PMS Hamburg:

- Wall junction box 4512 103 7538x
  inclusive connection block (25mm^2) for mains supply and connection block (10mm^2) for unit supply.
- Relay for radiation warning indicator 4512 100 4523x
  1 interface relay with a floating contact (230V/1A) is included in the scope of delivery of the generator.

8.2. Cables

H.V. cables

with O3 / O3 plugs: 9806 402 6xx02
length: . . . . 6m - 30m in steps of 2m
capacity: 155pF/m
diameter: 16.5mm
The cable length is indicated by the 9th and 10th digit of the numeric code.

Thermal contact cable

- 2-wire screened for 1 excess temperature switch 4512 100 66151
- 10-wire screened for additional supervision like
  temperature alarm switch, buzzer, selection indicator 0722 215 19005

Stator cable

3×1.31mm^2, screened 0722 215 02054

Note
The above described cables are part of the pre-installed systems.

AMPLIMAT cable

with D-Sub and 3-Plus plug:

12m 9890 000 01721
16m 9890 000 01731
20m 9890 000 01741
24m 9890 000 01751

Caution!
AMPLIMAT cables 9803 507 0xx02 (for hybrid measuring chambers 9803 509 xxxxx) with 3-Plus plugs at both ends must be connected in the generator by the following adapter for each cable:

Adapter for AMPLIMAT cable: 4512 108 09042. The generator includes 1 adapter.

The hybrid measuring chambers 9803 509 xxxxx require connection (chassis) between contacts:
D-Sub end GND (13) <---> RF 0V (8) (generator input)
or
3-Plus end GND (N) <---> RF 0V (J) (generator input)

This connection is established by the adapter for the AMPLIMAT cable.
See drawing Z1-6 ”Basic interface”.

In case a hybrid measuring chamber 9803 509 xxxxx is **not** operated with the required

AMPLIMAT cable ... 3-Plus / 3-Plus 9803 507 0xx02

but with

AMPLIMAT cable ... D-Sub / 3-Plus 9890 000 017xx

make sure to establish this connection (13 <---> 8) in the D-Sub connector!

For ALC measuring chambers 9890 000 016xx connection GND <---> RF 0V is not permitted.
Therefore, ALC measuring chambers AMPLIMAT cables 9890 000 017xx should always be used.

Operating desk

Note
Use the shortest cables. Noise immunity increases.

cable set 10m 9890 000 02411
20m 9890 000 02421
30m 9890 000 02431

8.3. Manpower

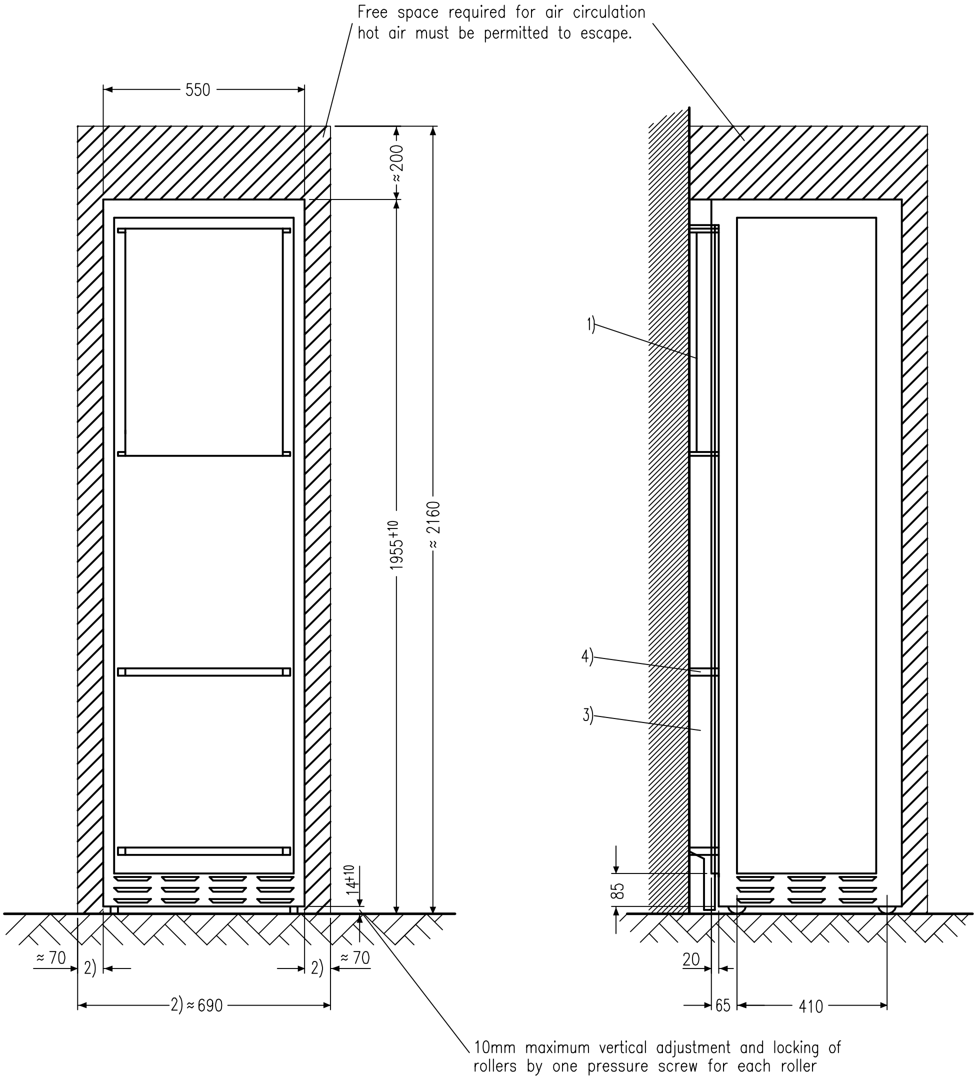
At least two persons are necessary to insert the H.V. tank in the generator cabinet.
The weight of the 2-tube version is about 88kg.

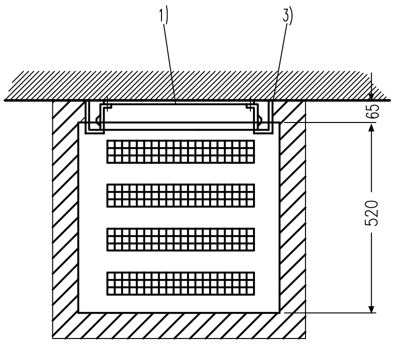
9. Planned maintenance

The technical documentation for carrying out maintenance work in compliance with the applicable regulations are available at the responsible authority of Philips Medical Systems.

The importance of having maintenance implemented is pointed out to the operator in the operating instructions.

It must be guaranteed that the person carrying out maintenance work knows about the respective national regulations and that this person observes these regulations throughout all steps of maintenance work.





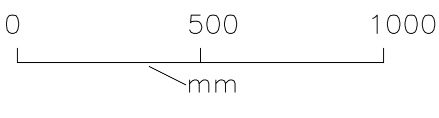
1) Wall junction box

2)Lateral clearance unless there is an adjacent cabinet

3) Filler panel

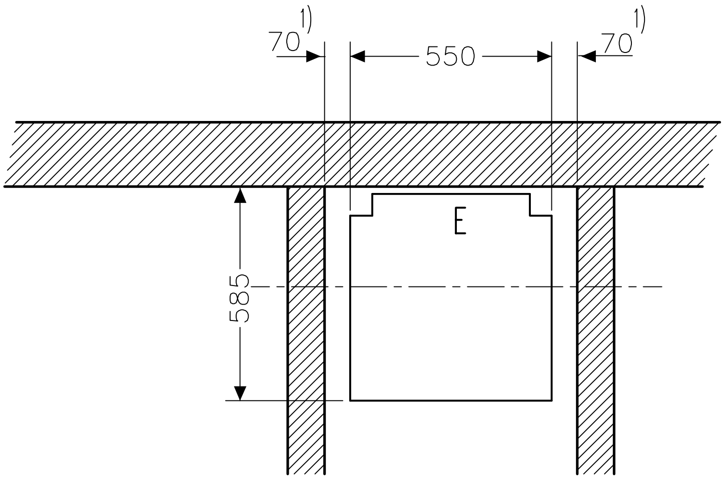
4) Wall–cabinet spacing angle

weight : 210 kg



A4 01–11–22 Schr/Ost.
4512982009 21_z1_1_010

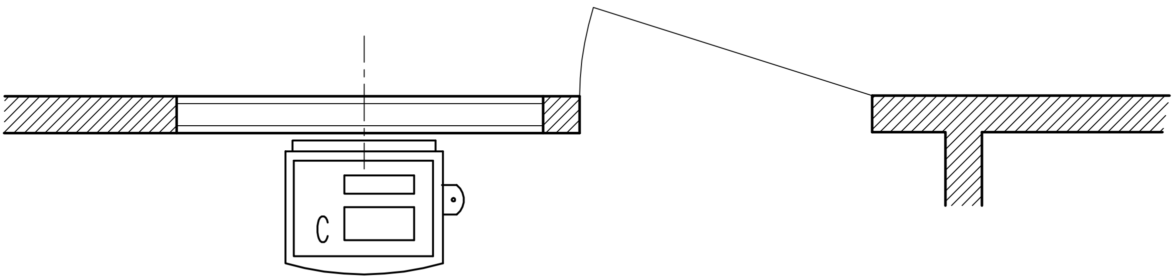
Generator Cabinet
Mechanical dimensions

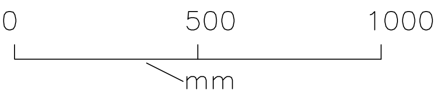


1) With no other
cabinets beside them

E= Control cabinet
(E not for OPTIMUS CD)

C= Operating desk

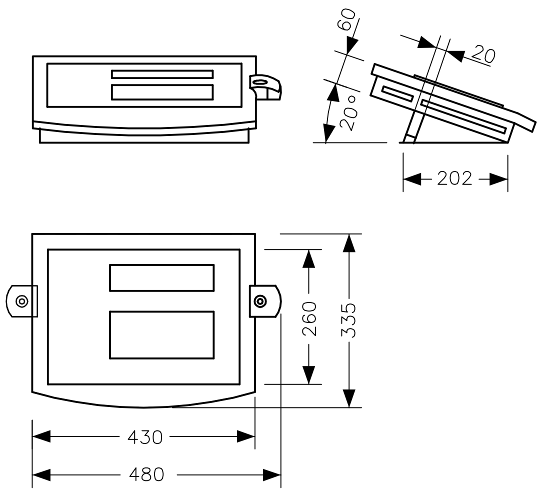




A4 01-11-22 Schr./Ost.
451298200921_z1_2_010

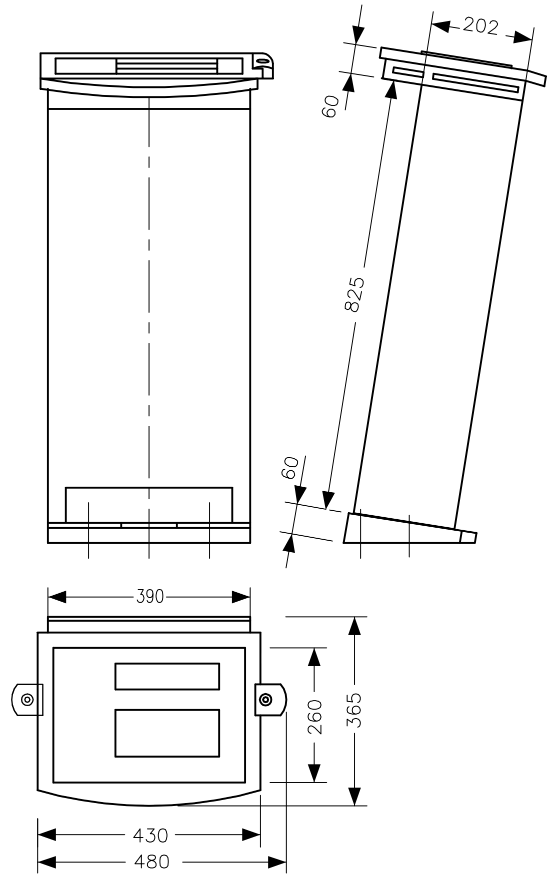
Room layout

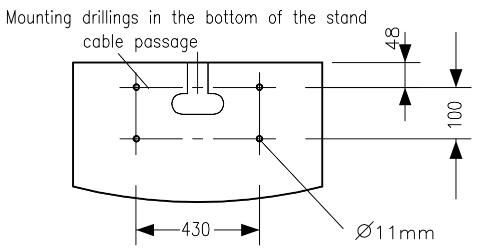
① Low profile control desk



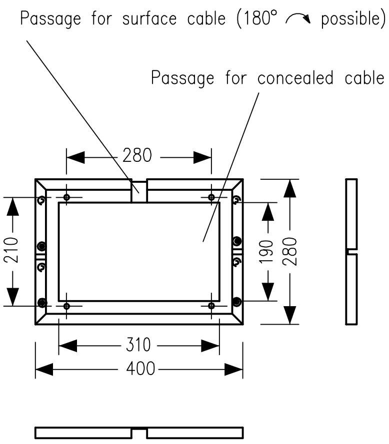
Note:
In this drawing the control desk is shown.
The dimensions are also valied for cockpit CB.

② Stand for low profile control desks



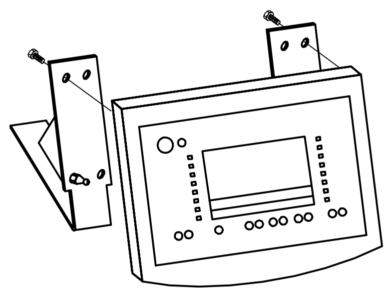


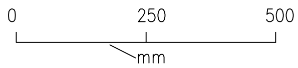
③ Wall–mounting support



④ User interface support

(not possible for digital DIAGNOST)

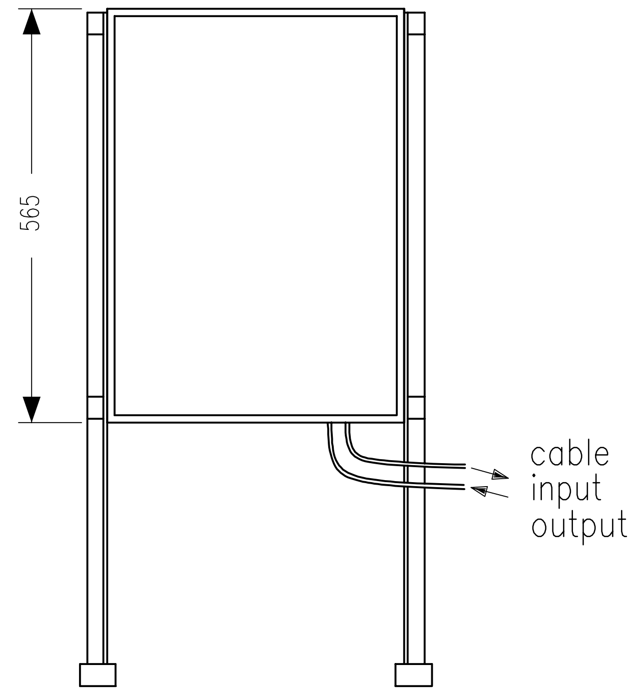


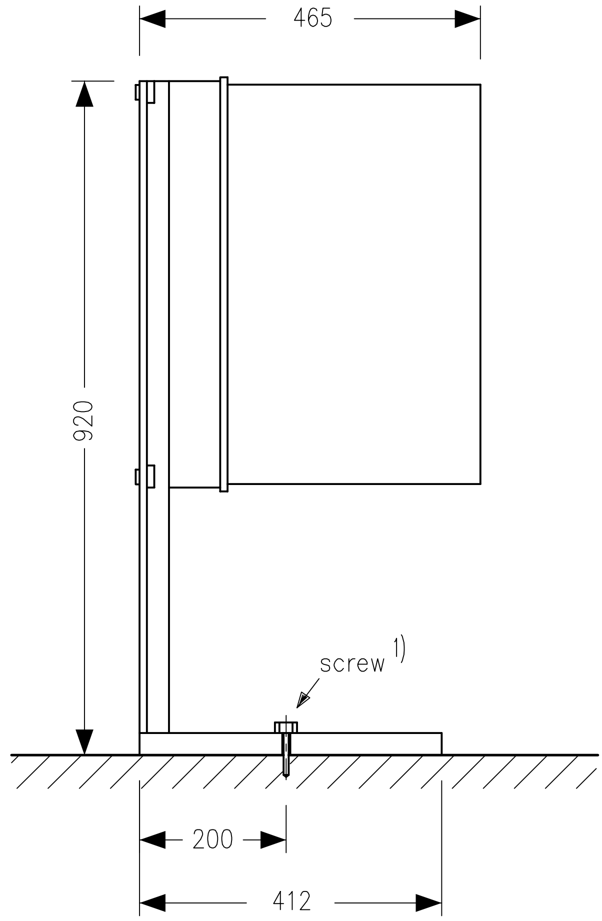


Operating panel
Mechanical dimensions

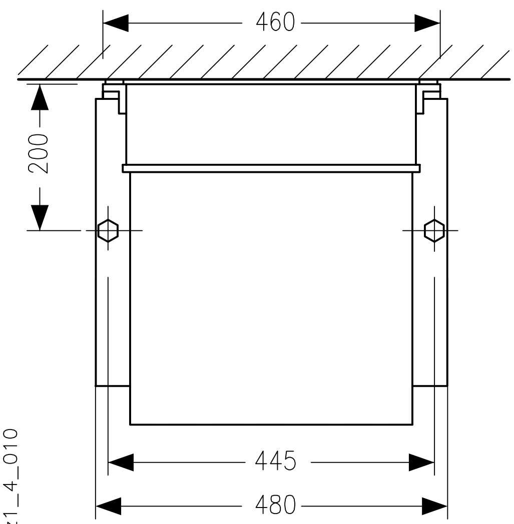
Product Planning Data

A3 01–11–22 Ost.
4512982200991_z1_3_010

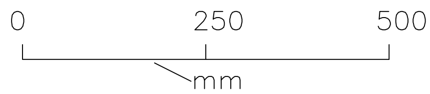




1) Screw connection (screws 7 x 60, dowels 8) only when requested. It is actually not needed

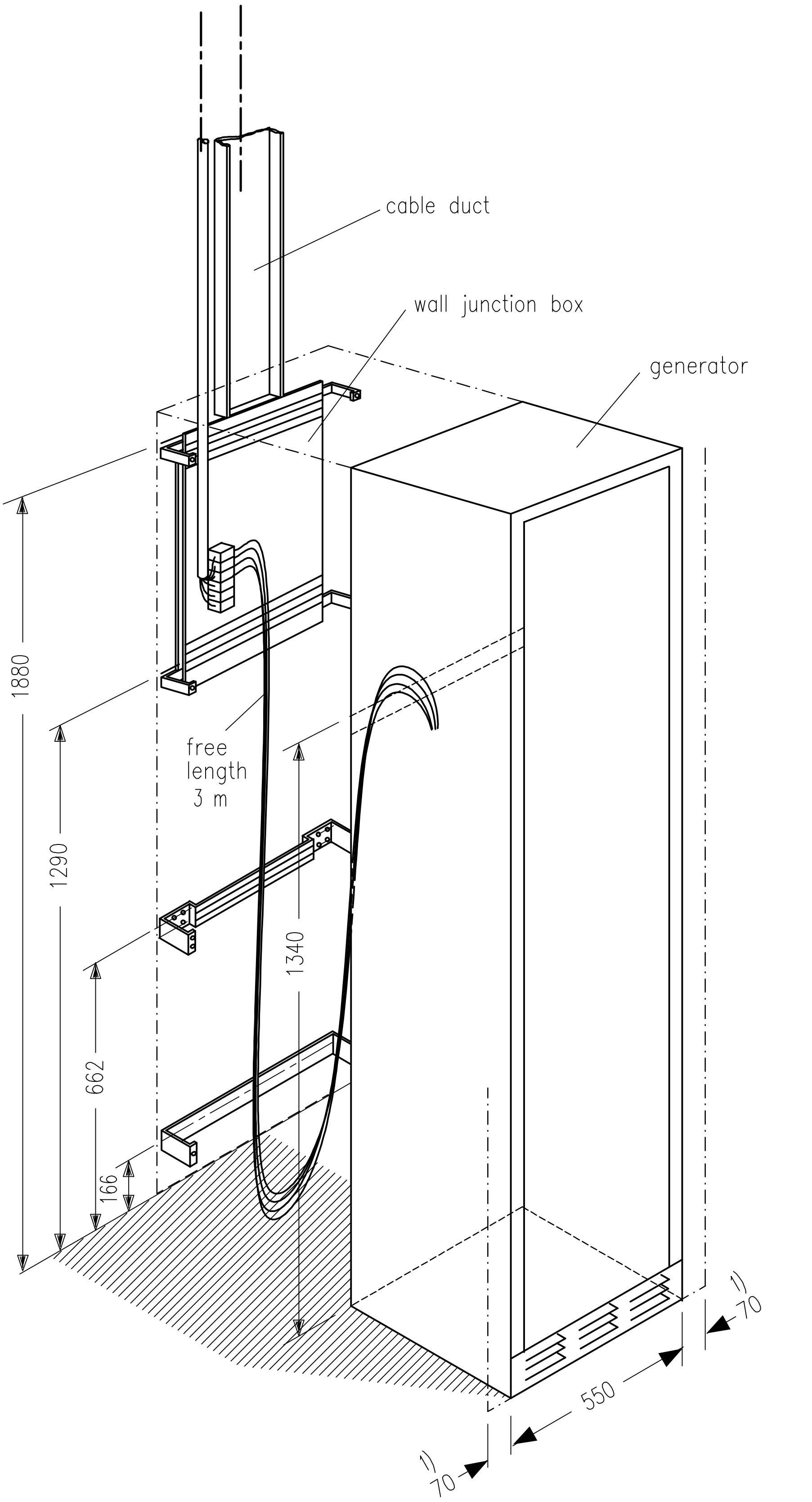


Weight 100 kg



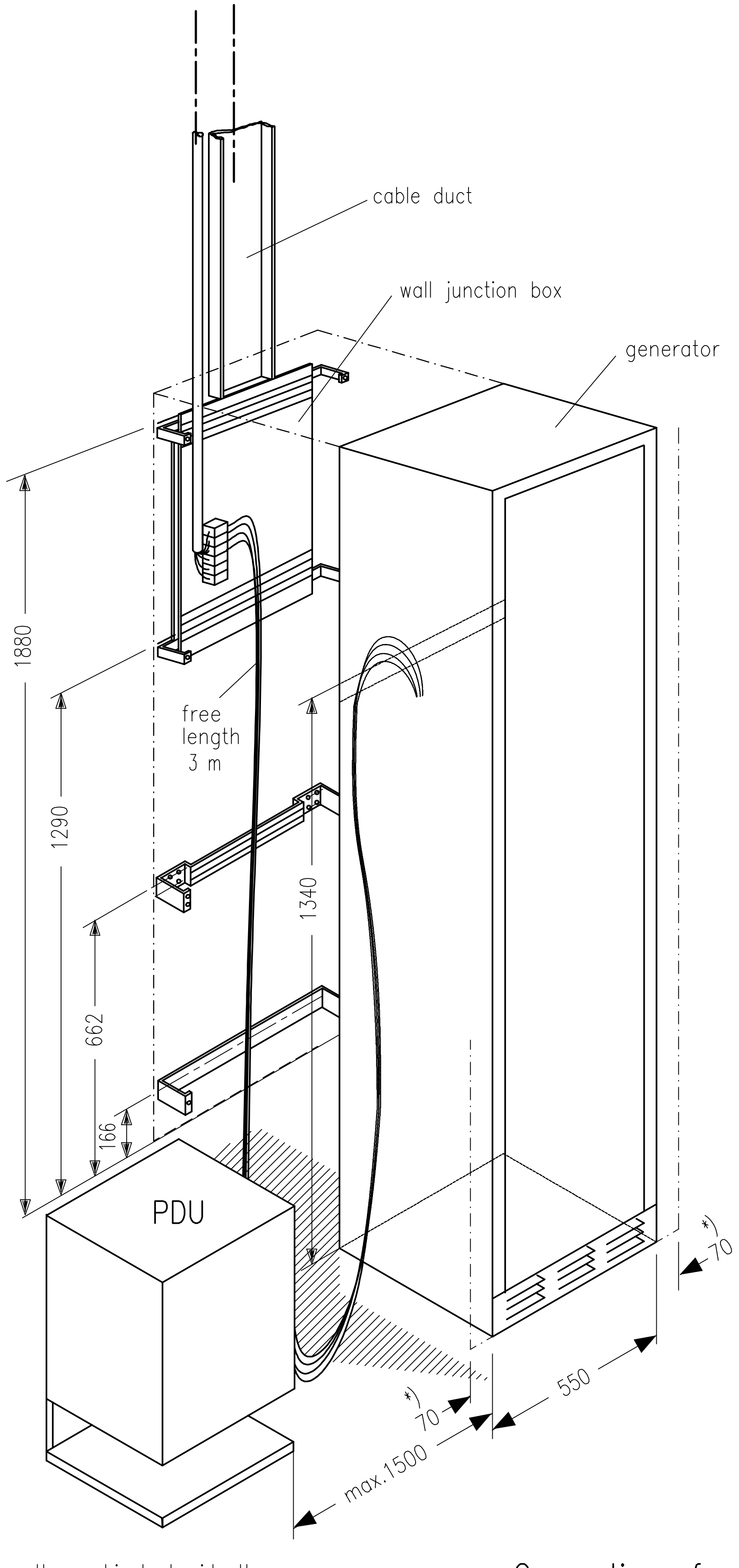
A4 01–11–23 Ost.
451298200991_z1_4_010

Power distribution unit (PDU)
9890 000 0260x
Dimensions and weight



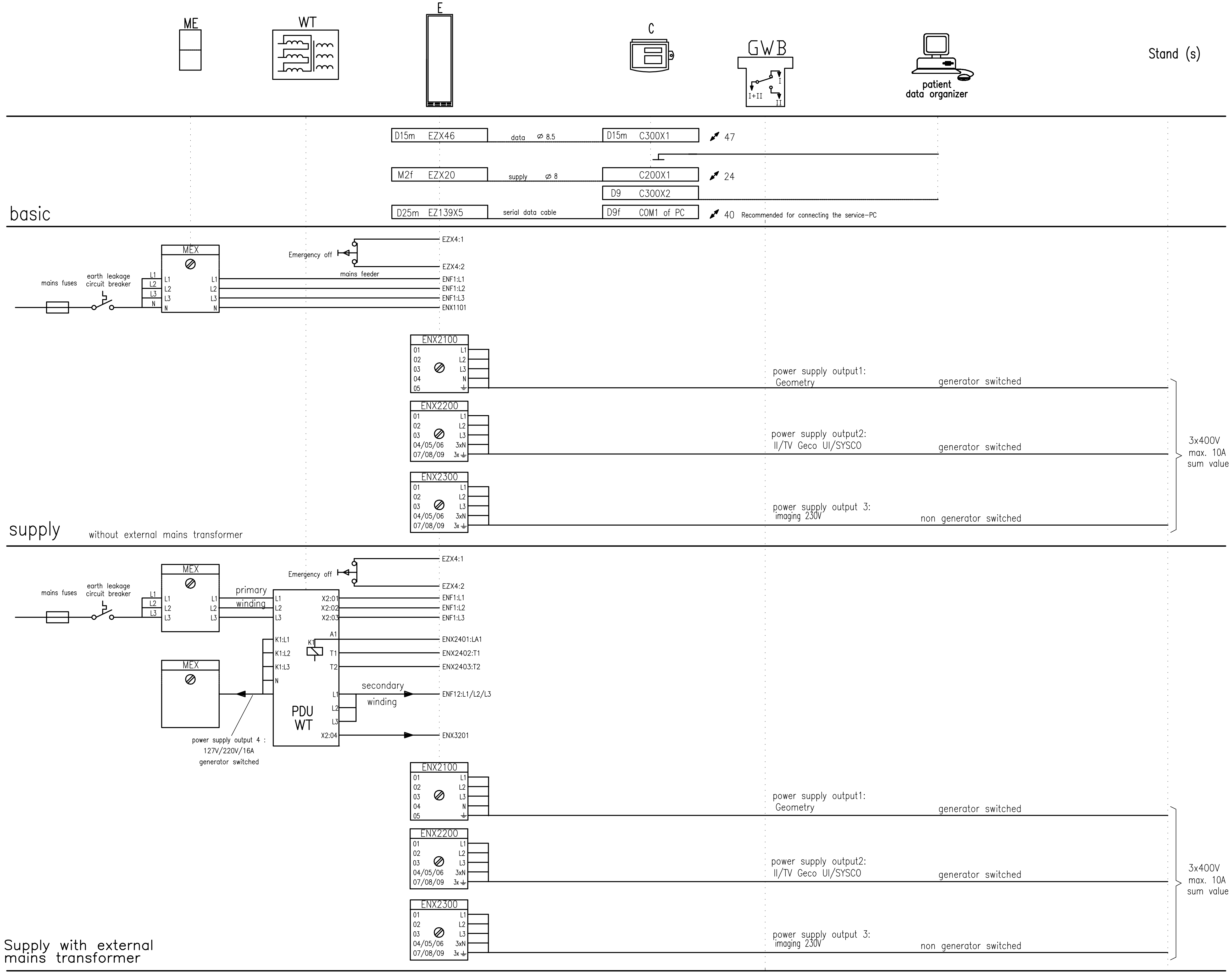
1) Space with no other cabinets beside them.

Connection of generator



*) Space with no other cabinets beside them.

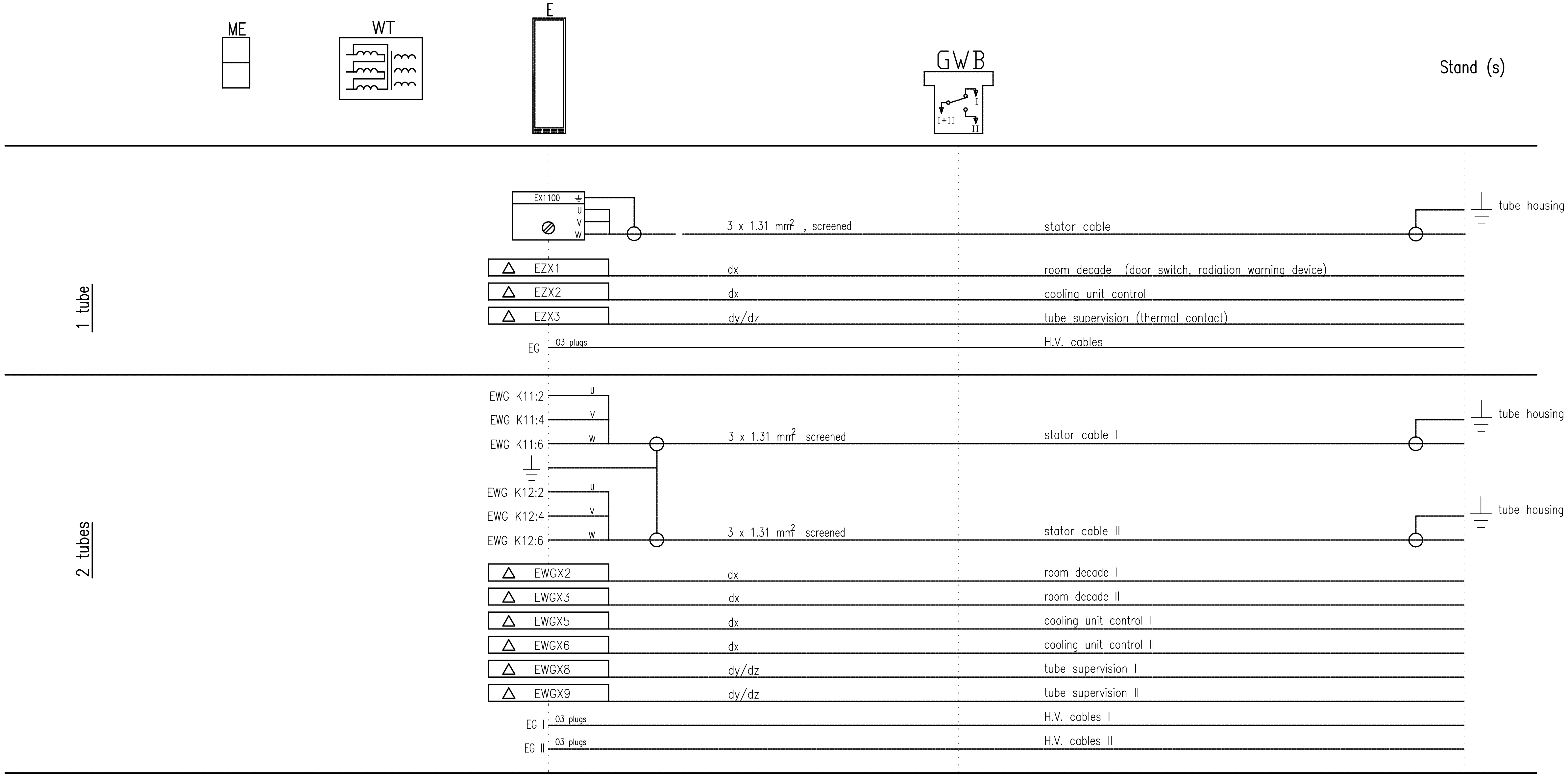
Connection of generator with Power Distribution Unit (PDU)



OPTIMUS R/F
Connection diagram

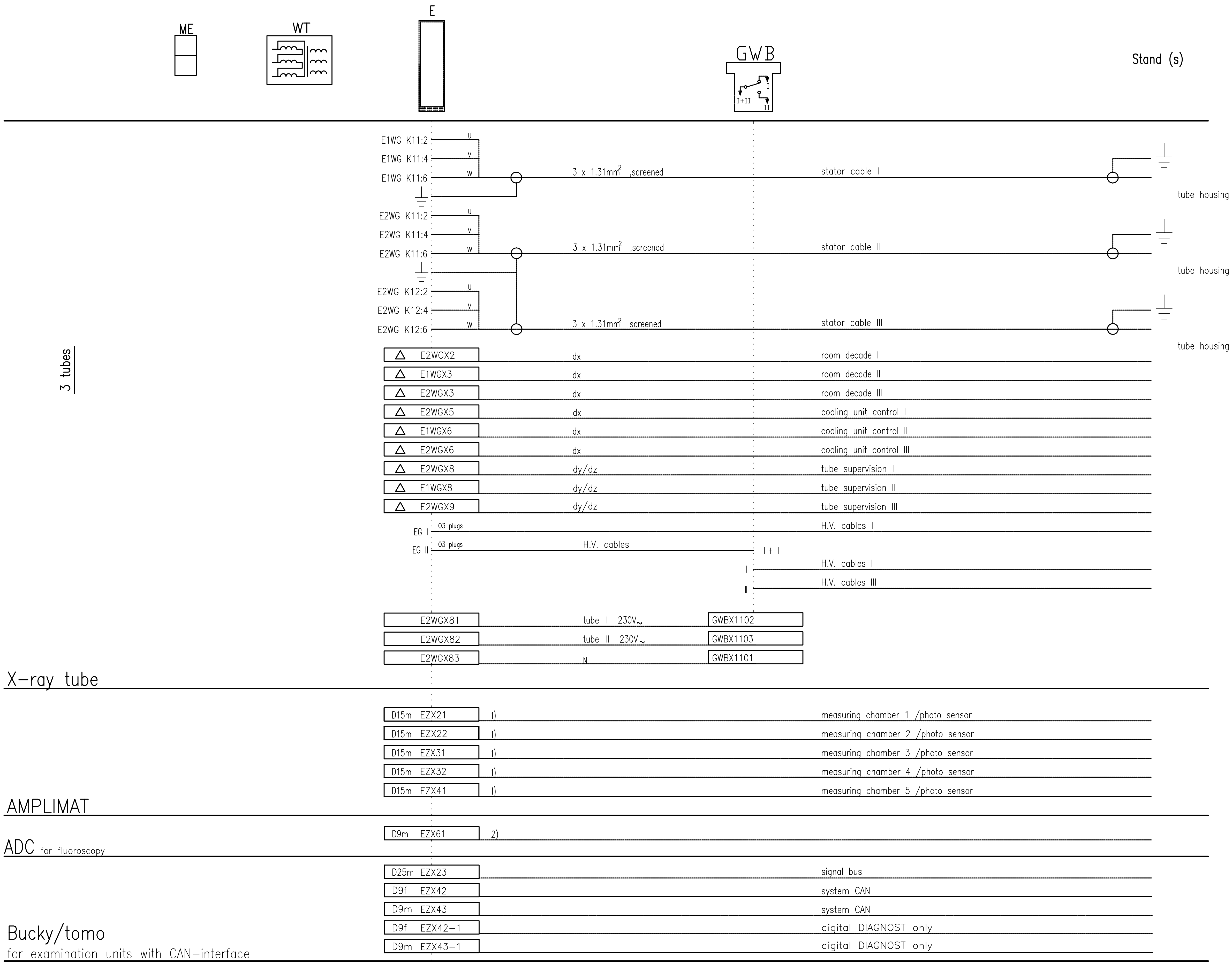
4512 982 0088. (01.0)

A3 01–11–21 Schr./Ost.
4512982008 82_z7_1_010



A3 01-11-23 Ost.
451298200881_z7_2_010

OPTIMUS R/F
Connection diagram

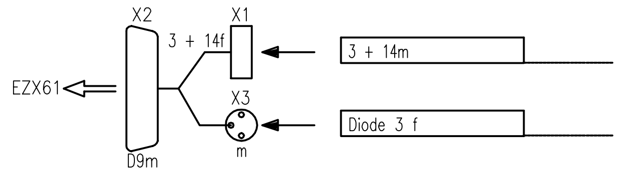


PRB-XRD products

A3 01-11-23 Ost.
451298200882_z7_3_010

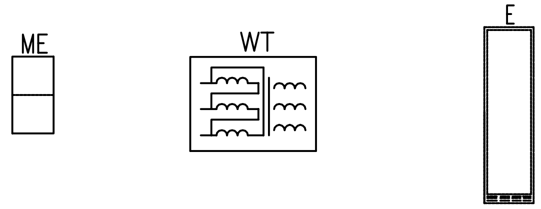
1) Adapter from 3 PLUS to Sub-D connector is available.

2) Adapter from Sub-D to 3 + and diode connector is in the scope of delivery



OPTIMUS R/F
Connection diagram

4512 982 0088. (01.0)



Stand (s)

device interface 1

1WAX1	dx	release 1	free attachable
1WAX2	dx	release 2	free attachable
1WAX3	dx	release 3	free attachable
1WAX4	dx	release 4	free attachable
1WAX11	dx	format contacts bucky 1 (... bucky/tomo okay)	
1WAX12	dx	format contacts bucky 2 (... bucky/tomo okay)	
1WAX14	dx	EXON	
1WAX21	dx	tomo times ←	
1WAX22	dx	tomo trajectories →	
1WAX23	dx	APR extension (2xRGDV, 6xAPR)	
1WAX24	dx	PSC external patient size compensation	

device interface 2

2WAX1	dx	release 1	free attachable
2WAX2	dx	release 2	free attachable
2WAX3	dx	release 3	free attachable
2WAX4	dx	release 4	free attachable
2WAX11	dx	format contacts bucky 1 (... bucky/tomo okay)	
2WAX12	dx	format contacts bucky 2 (... bucky/tomo okay)	
2WAX14	dx	EXON	
2WAX21	dx	tomo times ←	
2WAX22	dx	tomo trajectories →	
2WAX23	dx	APR extension (8xAPR)	
2WAX24	dx	PSC external patient size compensation	

Bucky/tomo
for examination units without CAN-interface

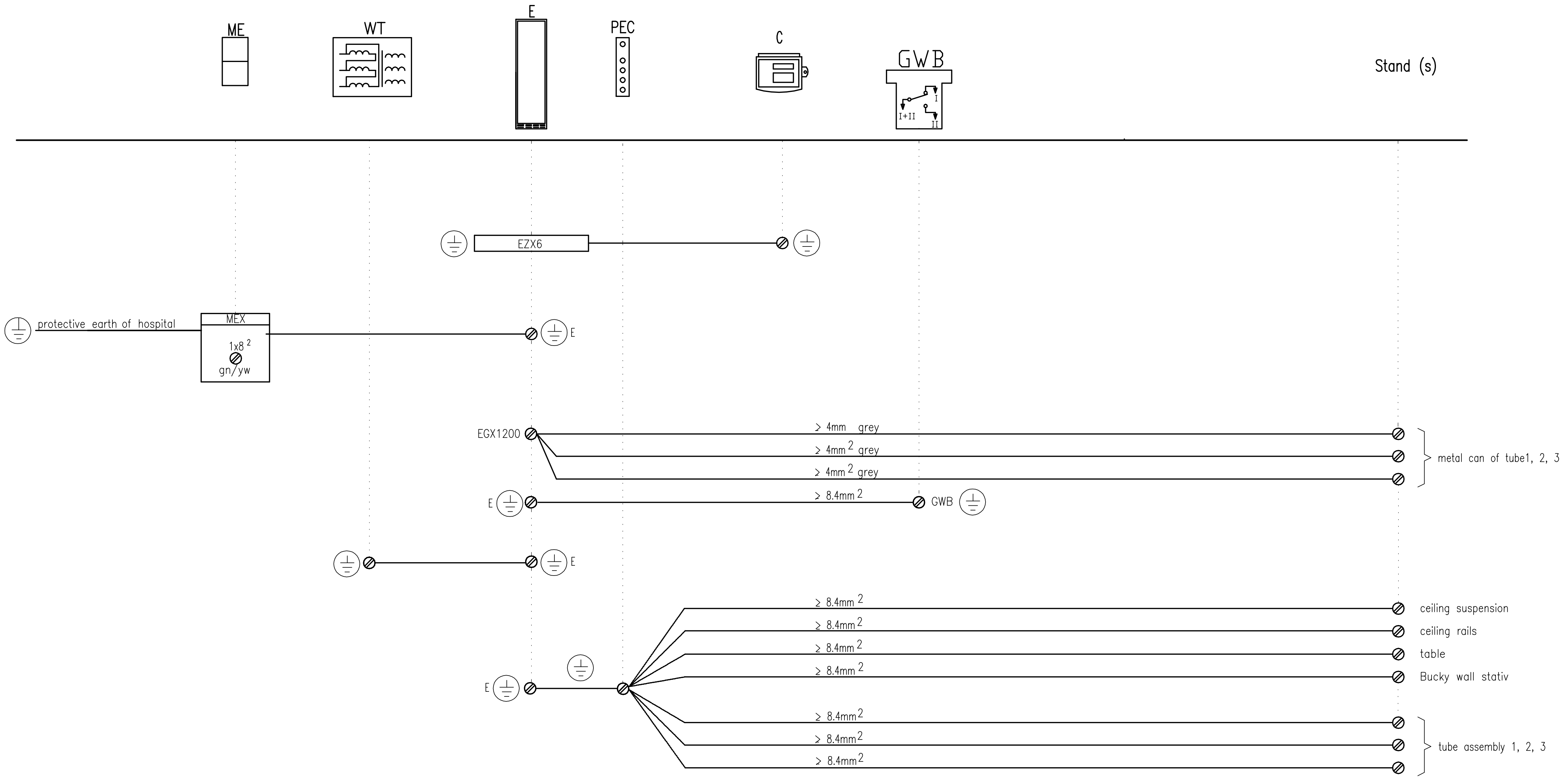
1WBX1	dx	release 1
1WBX2	dx	release 2
1WBX3	dx	release 3
1WBX4	dx	release 4
1WBX11	dx	format contacts bucky
1WBX12	dx	fluoro: Dose rate limit/lock in
1WBX13	dx	Format contacts serial changer
1WBX14	dx	EXON
1WBX21	dx	Change over cassette/camera
1WBX22	dx	Tubeshield decade
1WBX23	dx	External APRT
1WBX24		PSC external patient size compensation

Fluoro/Bucky

Products Planning Data

A3 01-11-23 Ost.
451298200881_z7_4_010

OPTIMUS R/F
Connection diagram



Product Planning Datata

A3 01-11-23 Schr./Ost.
451298200881_z7_5_010

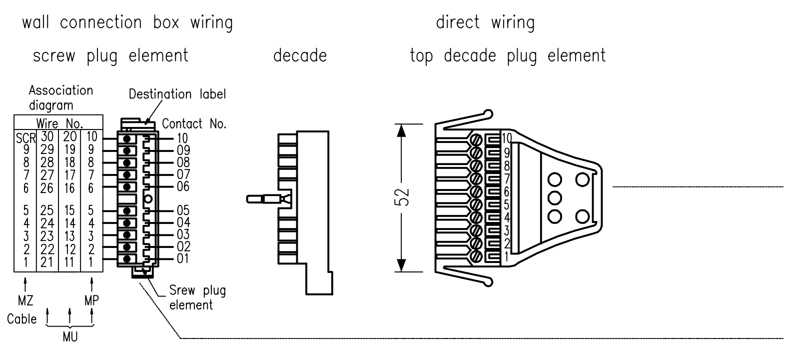
OPTIMUS R/F
Earthing diagram

System Planning Data

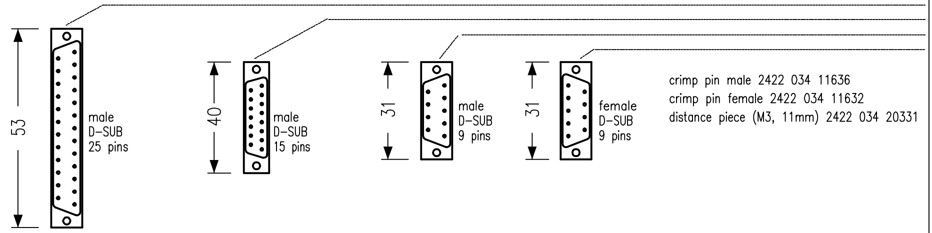
A3 01-11-22 Schr./Ost.
451298200101_z7_10_010

Orderinglist

– Connection plugs

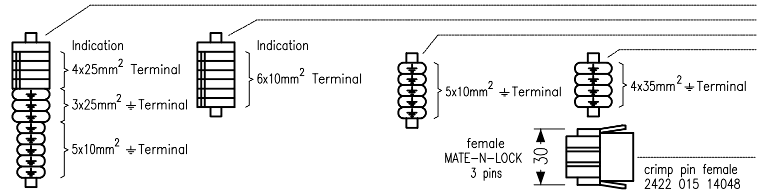


Codenumber	quantity
2422 025 04936	10 pieces
4512 126 25243	10 pieces

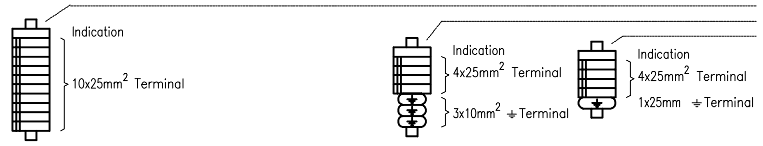


Codenumber	quantity
2422 025 05039	1 piece
2422 025 05038	1 piece
2422 025 05456	1 piece
2422 034 18334	1 piece

– Connector rails



Codenumber	quantity
4522 980 38051	1 piece
4522 980 18141	1 piece
4512 152 55244	1 piece
4522 980 38031	1 piece
2422 025 02991	1 piece



Codenumber	quantity
4522 980 18041	1 piece
4512 152 56761	1 piece
4522 980 18081	1 piece

– Cables

Description	Data	Codenumber	quantity
M (4 x 0.75 mm ^{2})	'8.0	0712 164 01002	xx metre
N (7 x 1.5 mm ^{2})	'13.5	0712 163 03001	xx metre
Q (18 x 1 mm ^{2})	'19.0	0712 163 00001	xx metre
R (25 x 1 mm ^{2})	'21.2	0712 164 10003	xx metre
MU (34 x 1 mm ^{2})	'21.1	4512 152 31061	xx metre
MP (12 x 1.5 mm ^{2})	'14.1	4522 100 85001	xx metre
MT ((4 + 1) x 10 mm ^{2})	'20.5	4512 152 31201	xx metre
MT ((4 + 1) x 16 mm ^{2})	'24.5	4512 152 31161	xx metre
MT ((4 + 1) x 25 mm ^{2})	'31.0	4512 152 31181	xx metre
MM (5 x 2.5 mm ^{2})	'14.3	0722 207 04022	xx metre
MY ((6 + 1) x 0.5 mm ^{2} screened)	'9.3	0722 212 02003	xx metre
MZ (9 x 0.82 mm ^{2} screened)	'15.6	0722 215 16002	xx metre
MW (2 x 0.82 mm ^{2})	'6.7	0722 300 01004	xx metre
da (3+1 x 1.38 mm ^{2})	'8.0	0722 207 03044	xx metre
db (3 x 1.3 mm ^{2} screened + yield) (AWG 16)	'9.2	0722 215 02054	xx metre
dc (2 x 0.8 mm ^{2})	'6.2	0722 300 01011	xx metre
dd (5 x 2 x 0.22 mm ^{2} screened)	'7.4 (twisted pair)	0722 215 62001	xx metre
de (12 x 2 x 0.22 mm ^{2} screened)	'9.6 (twisted pair)	0722 215 51007	xx metre
df (10 x 0.5 mm ^{2})	'7.3	4512 100 66451	xx metre
dg (10 x 0.5 mm ^{2} screened)	'7.8	0722 997 07248	xx metre
dh (8 x 2 x 0.22 mm ^{2} screened + yield)	'8.4 (twisted pair)	0722 215 33008	xx metre
dx (10 x 0.5 mm ^{2} mushroom)	'9.0	0722 276 05003	xx metre
dy (2 x 0.5 mm ^{2} mushroom , screened)	'5.3	4512 100 66151	xx metre
dz (10 x 0.5 mm ^{2} mushroom , screened)	'10	0722 215 19009	xx metre
(5 + 2) x 0.85 mm ^{2} stator cable	'11.5	0722 464 02003	xx metre
4 x 5.2 mm ^{2} stator SRC	'16.6		xx metre
1 x 4 mm ^{2} grey (AWG 12)	'5.4	0722 186 00536	xx metre
2 x 0.75 mm ^{2} screened	'6.5	0712 187 00002	xx metre
3 x 0.2 mm ^{2} screened	'6.0	0722 223 00002	xx metre
1 x 25 mm ^{2} PE	'9.0	4512 152 31141	xx metre
1 x 16 mm ^{2} PE		4512 152 31121	xx metre
1 x 8.4 mm ^{2} FE/PE (AWG 8)	'7.6	0722 186 00503	xx metre
1 x 6 mm ^{2} PE		4512 152 31241	xx metre
1 x 4 mm ^{2} PE		0722 186 00095	xx metre
1 x 16.7 mm ^{2} PE	'9.3	4512 100 66131	xx metre
1 x 8.25 mm ^{2} PE	'6.82	0722 186 00601	xx metre
8 mm – measuring chamber cable 8 m		XC 5070 /08	
12 m		XC 5070 /12	
16 m		XC 5070 /16	
20 m		XC 5070 /20	
24 m		XC 5070 /24	
28 m		XC 5070 /28	
H.V. (03 – 03, 150 kV)	'16.5	9806 402 6xx02	(xx = length in m)

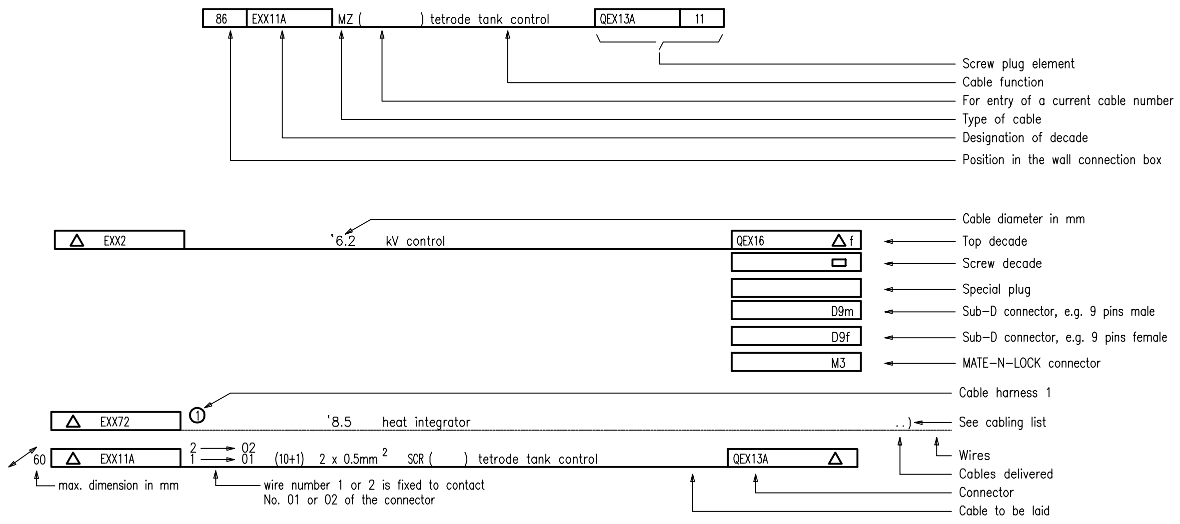
– Heading symbols

A	electronics cabinet angio
BL	electronics cabinet DSI
C	operators console
E	electronics cabinet X–ray generator
G	high tension tank frontal
GWB	H.V. changeover switch
HCU	hard copy unit
K	electronics cabinet TOMO
LHCU	laser hard copy unit
MC	wcb operators console
ME	wcb electronics cabinet X–ray generator
MK	wcb electronics cabinet TOMO
MON	monitor
MR	wcb electronics cabinet
MT	connection box wall bracket
MU	overhead connection box ceiling crane
R	electronics cabinet
S	bucky table
U	ceiling crane
UB	ceiling crane longitudinal carriage
UT	wall bracket
UZ	ceiling crane
vD	vertical DIAGNOST 1/2/4
bD	bucky DIAGNOST VE/VT
VP	wcb bucky DIAGNOST
wcb	wall connection box

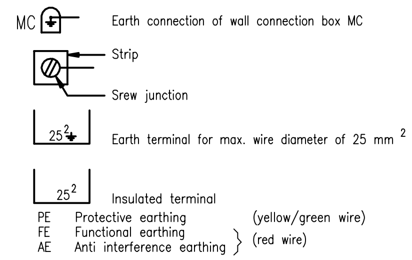
– X–ray beam symbols

BB	image intensifier
BD	image distributor
BK	I I camera
LA	collimator
SA	film plane
WK	TV camera
XA	X–ray tube

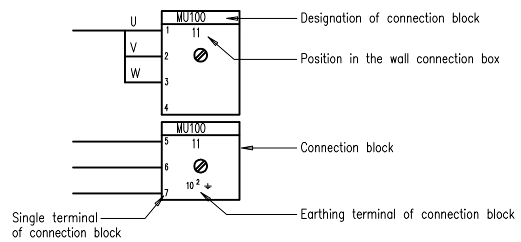
– Cable symbols



– Earthing



– Connection blocks



Legend for earthing and cabling diagram

INSTALLATION

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RGDV programming example: 5 . . . . 2Z-2.5
RGDV programming example: 6 . . . . 2Z-2.6
RGDV programming example: 7 . . . . 2Z-2.7
RGDV programming example: 8 . . . . 2Z-2.8
RGDV programming example: 9 . . . . 2Z-2.9
RGDV programming example: 10 . . . . 2Z-2.10
List of characters 2Z-3
Data sets of chambers 2Z-4
Programming of device interfaces 2Z-5
Labelling 2Z-10

1. Installing the wall junction box

- Mount the wall junction box at the place where the generator is intended to be installed.
  (See drawing “Connection of generator” in section 1 and manual UNIT 4512 103 75380 for wall junction boxes).
- If necessary, install the optional surge arrester WN inside the wall junction box.
  (See surge arrester documentation.)
- If applicable, mount the filler panels of the generator to the wall junction box.
- Have the mains cable present at the clinic connected to mains terminal MEX by a person who is authorized for this job.
- Check the phase sequence of L1, L2 and L3.

Warning!
Switch OFF the mains supply present at the clinic and make sure that it cannot be switched ON again accidentally.

2. Preparatory work

2.1. Mounting of the H.V. generator in the cabinet

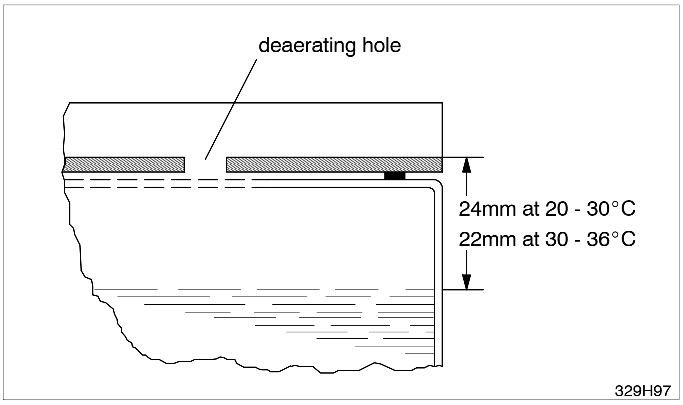
Caution!
Do not tilt the H.V. generator while transporting it.

In case of a tilting angle larger than 45°, the setting-to-work of the generator can be started not before a waiting time of about 8 hours has passed. Otherwise the H.V. generator may be destroyed by electrical sparkover.

- Unpack generator cabinet E.
- In case the packing material is strongly soiled with oil check the oil level. Repair it if necessary.

  Tolerance: ±2mm

  Oil: Shell Diala G in 2.5l container
  4512 148 43172



- Remove the deaerating screw completely from the cover of the H.V. generator. Only this way the precision of the high voltage measuring divider corresponds to the specification.
  In case of return shipment of the H.V. generator this screw must be fixed again. Therefore, keep the screw laying on top of the cover.

Caution!
Make sure that no foreign matter falls into the oil. Otherwise the transformer must be exchanged.

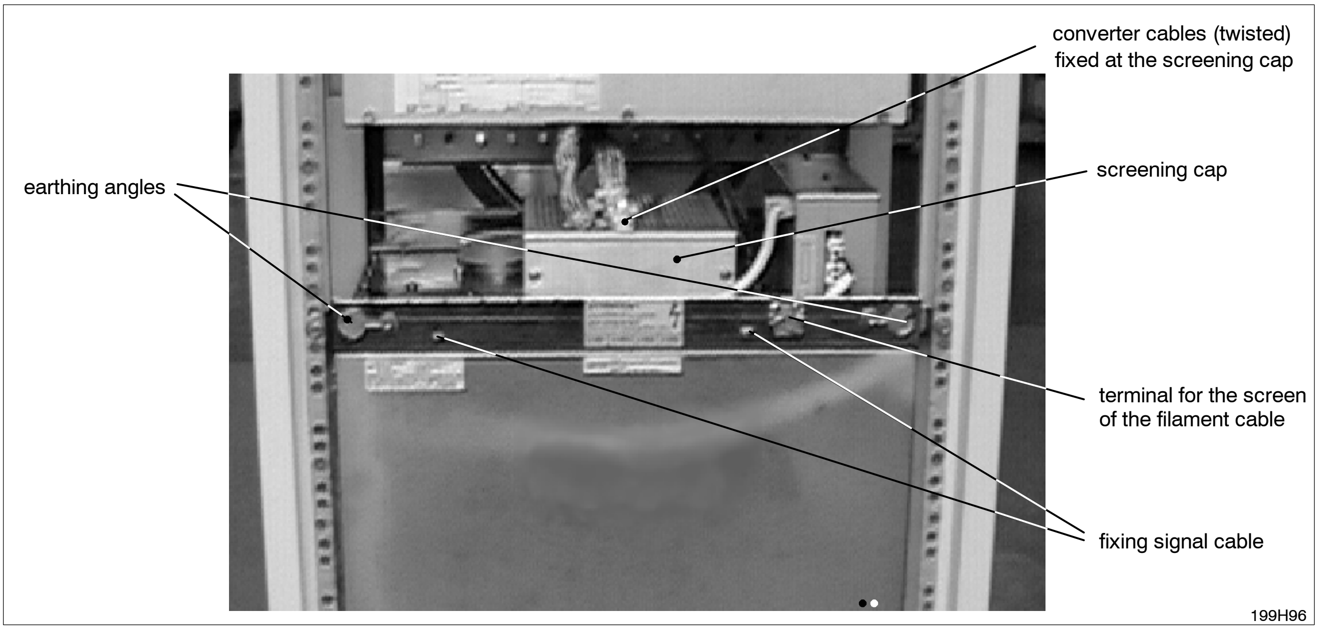
- Take the two transport bars from the rear side of the cabinet.
- Lift the H.V. generator into the generator cabinet with the transport bars.
  The 4 connecting bolts GX1001 to 1004 must point at the front of the generator cabinet.

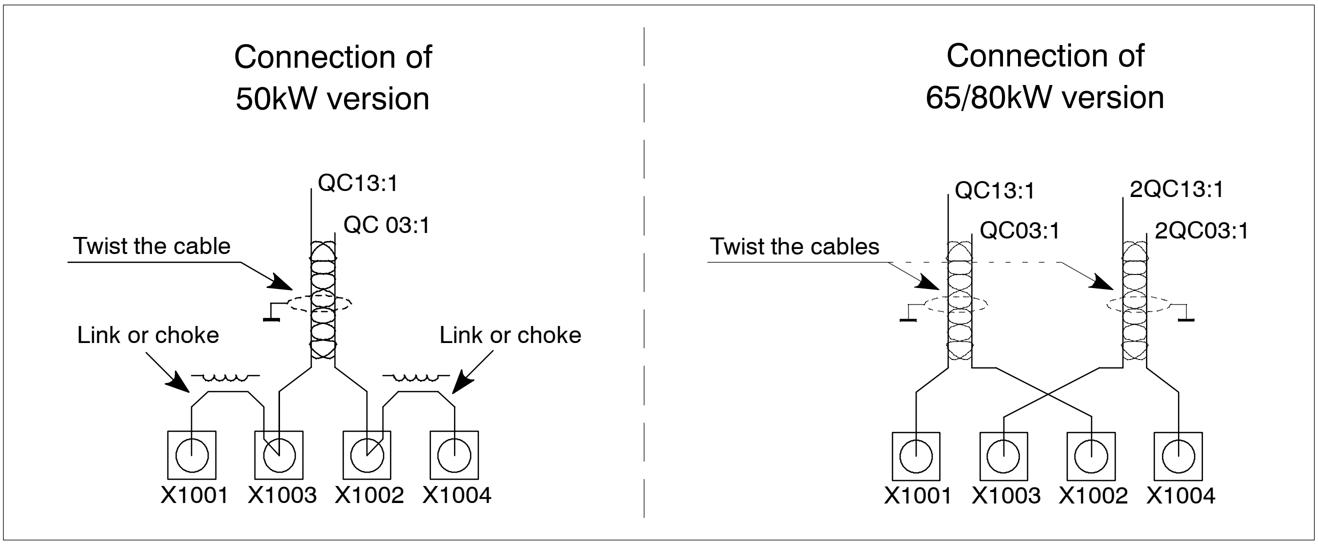
2.2. Electrical connection of the H.V. generator

- Connect the H.V. generator electrically:

Generator version	Connection from	<--->	to	Remark
50/65/80kW	E1 (GND)	<--->	GX1100 (GND)	Ground
	ZX12	<--->	G100X15	Route the cables along the front and left-hand edge of the H.V. generator. Fix them.
	ZX35	<--->	G100X14	
50kW	QC13:1	<--->	GX1003	Twist the cables! **Note** *The sequence of the connecting bolts is not in numerical order.* *See drawing page 2-4.* Push the screening cap forward over the connecting bolts and tighten it. Attach the converter cables including the screening to the screening cap with cable ties.
	QC03:1	<--->	GX1002	
	GX1001	<--->	GX1003	The 50kW version might have direct links on each side or a link on one side and a choke of 1 ... 6 loops on the other side for the reason of kV symmetry. **Note** *Do not change these links or chokes.*
	GX1004	<--->	GX1002	
65/80kW	QC13:1	<--->	GX1001	Twist the cables! **Note** *The sequence of the connecting bolts is not in numerical order.* *See drawing page 2-4.* Push the screening cap forward over the connecting bolts and tighten it. Attach the converter cables including the screening to the screening cap with cable ties.
	QC03:1	<--->	GX1002	
	2QC13:1	<--->	GX1003	
	2QC03:1	<--->	GX1004	
50/65/80kW 2nd tube	WGX61	<--->	GK1:1	
	WGX67	<--->	GK1:2	
	WGX62	<--->	GK2:1	
	WGX68	<--->	GK2:2	

- Turn the two earthing angles of the H.V. generator outward and screw them on to the members of the cabinet.





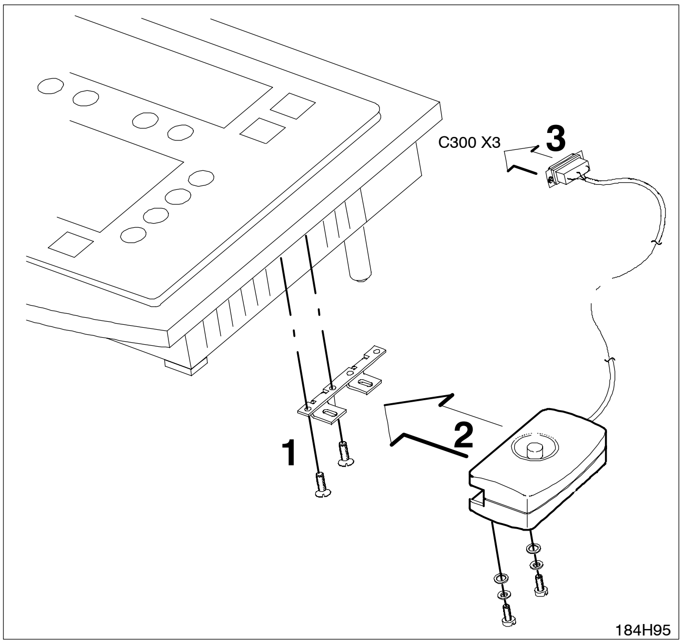
3. Installing the operating panel

3.1. Desk version

See ”Operating panel” in section 1.

Accessories:

- 2 feet for the unit
- 2 elastic buffers, black
- 5 insert strips for the RGDV buttons
- sheet with RGDV symbols
- release switch



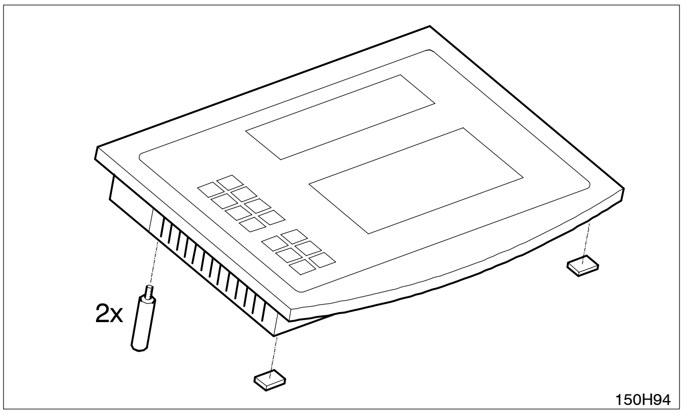
184H95

- Unpack the desk carefully.
- Mount the release switch on the left-hand or right-hand side of the desk:

  Mount the holding bracket to the edge of the desk (1) with the two M4x10 countersunk screws.

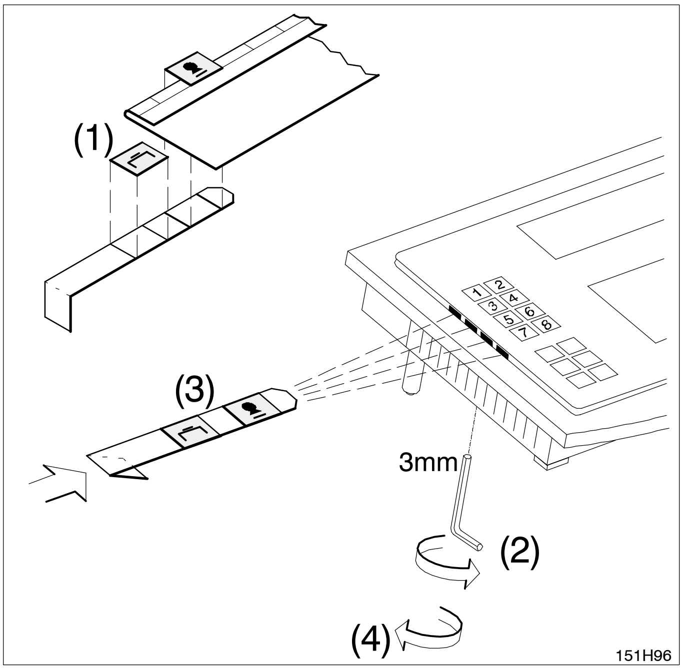
  For visual reasons the release button should be in line with the +/– buttons on the control desk. Use the appropriate holes in the bracket.

  Slide the release switch onto the bracket.
  Fasten it parallel to the desk edge with the two M4x10 cheese-head screws, securing rings and washers (2).



150H94

- Screw in the 2 feet for the unit at the bottom of the desk.
- Glue the 2 black elastic buffers to the front edges of the bottom of the desk such that they are acting as the front feet.



- Define the assignment of the RGDV buttons 1 ... 8. Glue the respective symbols to the insert strips which are provided with subsidiary lines (1).
- Raise the keyboard about 3mm above the desk. Use an allen key (2).
- Push the insert strips under the keyboard foil. Press the angulated, protruding end of each insert strip into the housing of the desk (3).
- Lower the keyboard to its initial position (4).
- Remove the cable cover at the rear side of the desk.
- Connect the cables:

Supply cable	EZX20	<--->	C200X1
	EZX6	<--->	earth
Data cable	EZX46	<--->	C300X1
Release switch		<--->	C300X3
Patient Data Organizer		<--->	C300X2 (option)

- Check the function programming plug for X44 as shown in Z2-5.2 and put it into socket EZX44.
- Provide drag relief for the supply and data cables with the clamp present on the desk.
- Screw on the cable cover.
  Make sure that the cable drag relief device of the release switch (1 cable tie) remains under the cover.

3.2. Stand version

See ”Operating panel” in section 1.

Additional accessories:

- 4 dowels S10
- 4 hexagon cap screws 8 x 60mm
- 4 washers

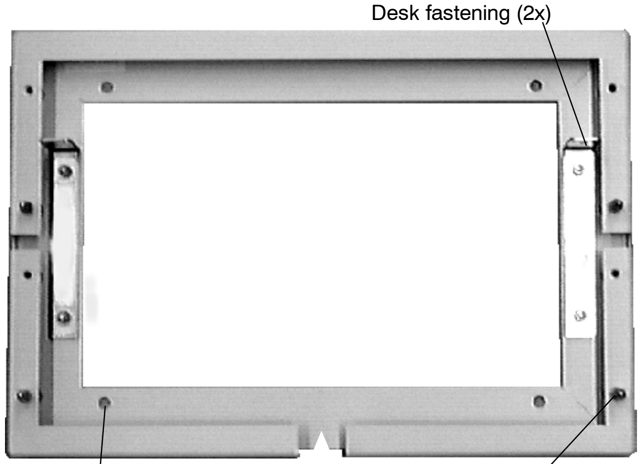
- Position the desk stand according to the respective room layout.
- Mark the fixing holes on the floor.
- Set the 4 dowels supplied into the floor (drill bit: 10mm).
- Screw on the desk stand with 4 screws and washers.
- Route the supply and data cables from the bottom to the top within the desk stand.
  Provide the cables with drag relief.
  Cable ends including plugs should protrude beyond the edge of the desk by about 500mm.
- Mount the release switch as described in chapter 3.1.
- Assign the RGDV buttons 1 ... 8 to the desired symbols as described in chapter 3.1.
- Connect the cables to the desk as described in previous chapter 3.1.
- Screw on the cable cover.
  Ensure the cable drag relief device of the release switch (1 cable tie) remains under the cover.
- Mount the operating panel on the stand.

3.3. Wall mounted version

See ”Operating panel” in section 1.

Additional accessories:

- 4 ball-head bolts
- 4 dowels S8
- 4 hexagon cap screws 5 x 30mm
- 4 washers
- 2 screws 4 x 10mm
- 2 angle plates
- 4 nuts



- Screw on the angle plates into the wall frame. The short ends of the angles must be pointing upwards.
- Screw the 4 ball-head bolts into the wall support.
- Mark the 4 fixing holes of the wall frame at the respective place on the wall.
- Set the dowels supplied into the wall (drill bit: 8mm).
- Screw on the wall frame with the 4 hexagon cap screws and washers.
- Provide drag relief for the supply and data cables in the wall frame.
  Cable ends including plugs should protrude beyond the edge of the desk by about 500mm.
- Mount the release switch as described in chapter 3.1.
- Assign the symbols to the desired RGDV buttons 1 ... 8 as described in chapter 3.1.
- Connect the cables to the desk as described in previous chapter 3.1.
- Mount the operating panel on the wall frame and fix it with the left two screws.
- Screw on the cable cover.
  Ensure the cable drag relief device of the release switch (1 cable tie) remains under the cover.

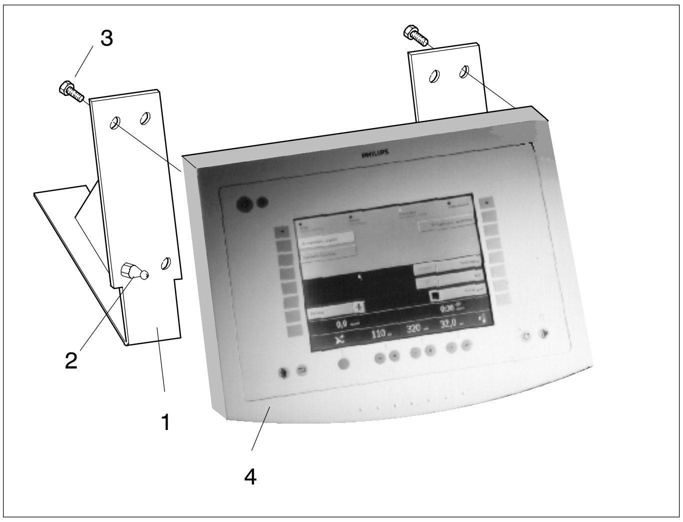
The wall frame is designed symmetrically.
In case connection cables come from above the frame can be mounted upside down.
Only the ball-head bolts and the angle plates still keep their position.

3.4. Supporting angle version

- Screw the ball-head bolts (2) into the supporting angles (1):

  Left angle ---> on the left at the bottom
  Right angle ---> on the right at the bottom

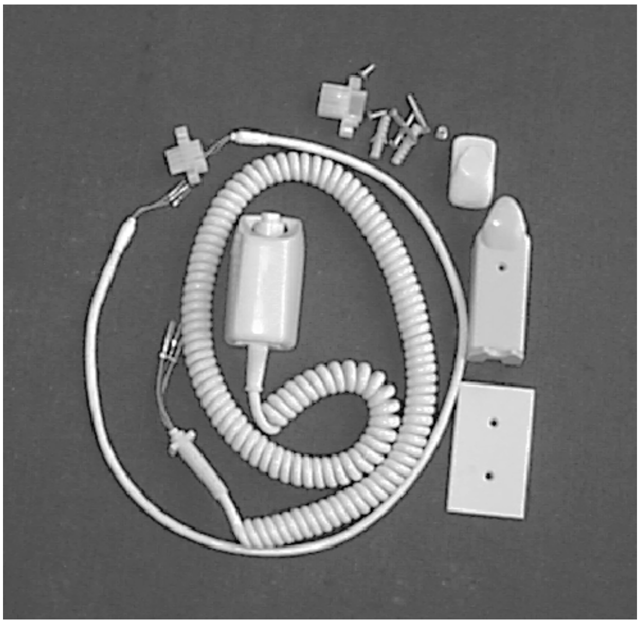
- Press the ball-head bolts (2) into the respective snap bushing of the desk (4).
- Fix the supporting angles (2) to the desk (4) with the 2 screws M4 (3).



3.5. Additional release switch

An optional second release switch is supplied with a longer spiral cable: 9890 000 0249x

The scope of delivery includes various wall hooks and an adapter cable. Electrical connection is made in parallel with the existing release switch which is mounted on the desk itself.

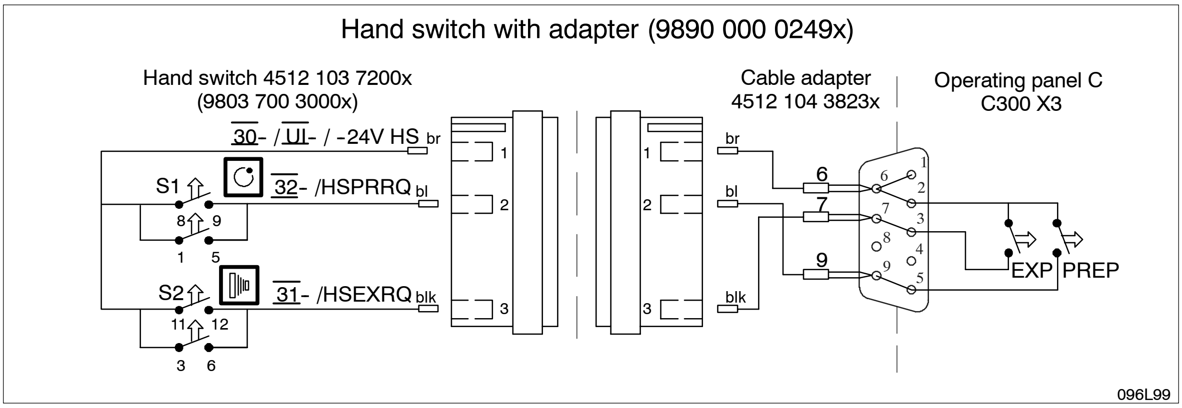


- To do this, plug the pins of the adapter cable into the D-Sub connector of the existing release switch.

  Sequence:

Adapter: connector pin	<--->	D-Sub: connector pin
1	<--->	6
2	<--->	9
3	<--->	7

Reference: Figure below and drawing Z1-11.1 “Operating panel C” in section Z1 “Schematic drawings”.



4. Electrical connection

4.1. Earthing

See "Earthing diagram" in section 1.

4.2. Mains connection

4.2.1. Mains connection of the generator

Warning!
Switch OFF the mains supply present at the clinic and make sure that it cannot be switched ON again accidentally.

See "Connection diagram" in section 1.

- Measure the internal mains resistance at the terminal MEX with a suitable measuring instrument.

L1 - L2: R_i = ... mΩ
L1 - L3: R_i = ... mΩ
L2 - L3: R_i = ... mΩ

Required max. mains resistance at generator input:

Mains voltage	Mains resistance		
	30kW	50kW	65/80kW
190V *	–	40mΩ	–
220V *	130mΩ	60mΩ	–
240V *	160mΩ	80mΩ	–
380V	500mΩ	300mΩ	200mΩ
400V	500mΩ	300mΩ	200mΩ
440V	500mΩ	350mΩ	240mΩ
460V	500mΩ	350mΩ	240mΩ
480V	500mΩ	400mΩ	300mΩ

* with external mains transformer (max 50kW)

Maximum permissible internal mains resistance: 500mΩ
Internal resistance of **P**ower **D**istribution **U**nit PDU: 20mΩ at 50Hz
23mΩ at 60Hz

Caution!
Connect phase wires in correct phase sequence.

- Connect the mains cable of the generator to terminal MEX: L1 / L2 / L3 within the wall connection box. If the optional **P**ower **D**istribution **U**nit **PDU** WT is fitted, connect the cables at that point to terminal WTX2.
- Connect the examination unit supply (max. 10A) to (230V / 400V):

Output 1	Geometry power	ENX2101/...5
Output 2	I.I. / TV; GECO; UI; SYSCO	ENX2201/...9
Output 3	Imaging	ENX2301/...9

Output 3 not switched by generator

4.2.2. Mains connection of the PDU

See delivered Unit Manual “Power Distribution Unit”.

4.3. Stator connection

4.3.1. Shielding

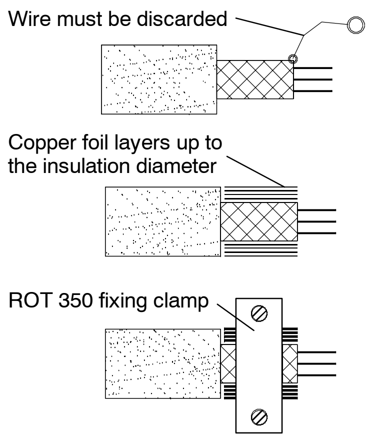
Caution!
To suppress interferences of the high-speed rotor control, the stator connections must be provided with a 360° screen at the tube and generator end.

General remarks:

- Always use screened cables: 0722 215 02054.
- Shorten the stator cable to the required length. Do not accommodate excess lengths at the generator.
- Keep stator cable separate from all the other signal cables to avoid interference.
- Earth the screen at both cable ends.

Screening procedure:

- Remove any enamel or dirt from the clamp providing drag relief in the tube housing to make sure the clamp is conductive.
- Remove the plastic covering around the clamp, about 1cm (0.5").
- Wrap copper foil around the visible screen of the cable until the original diameter of the cable is obtained.
- Remove the present red wire going from the screen end to the earthing point of the tube housing.
- Fix the screen of the stator cable with the clamp. Ensure that the clamp is secured and the ground contact works!



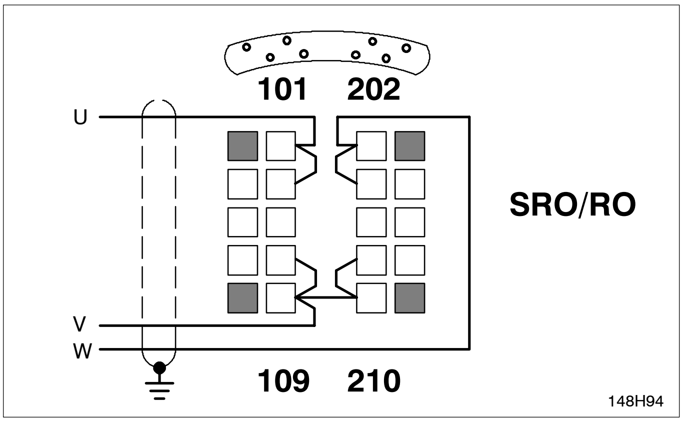
Screening of the stator cable.

4.3.2. Connection

Caution!
Do not mix up the phases, otherwise components of the rotor control may be destroyed.

At the tube end

- Place the jumpers across terminals 100 and 200 according to the figure.



- Connect the stator cable:

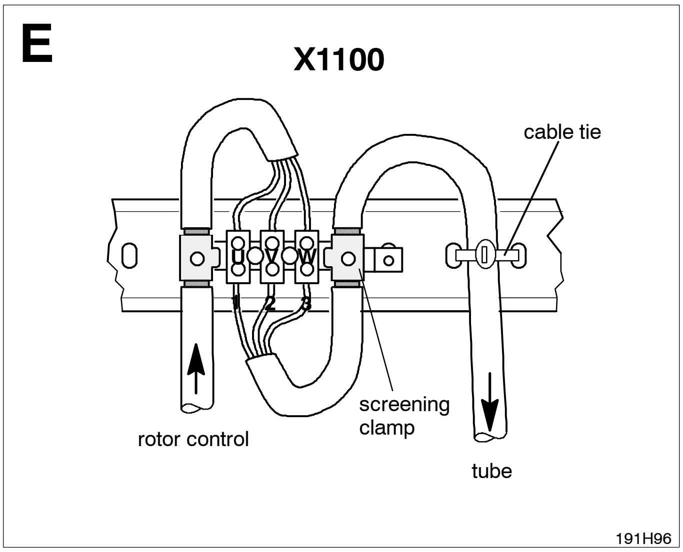
  wire 1 ---> phase U
  wire 2 ---> phase V
  wire 3 ---> phase W

- Earth the screening of the stator cable at the tube housing with the metallic clamp.

At the generator end: One-tube version

See "Connection diagram" in section 1.

- Connect the stator cable to the terminal EX1100 (U-V-W).



- Check the stator connection by measuring the resistances:

U – V	=	wire 1 – 2	≈	11Ω
U – W	=	wire 1 – 3	≈	20Ω
V – W	=	wire 2 – 3	≈	9Ω

- If an inductance meter is available, measure the following inductance values:

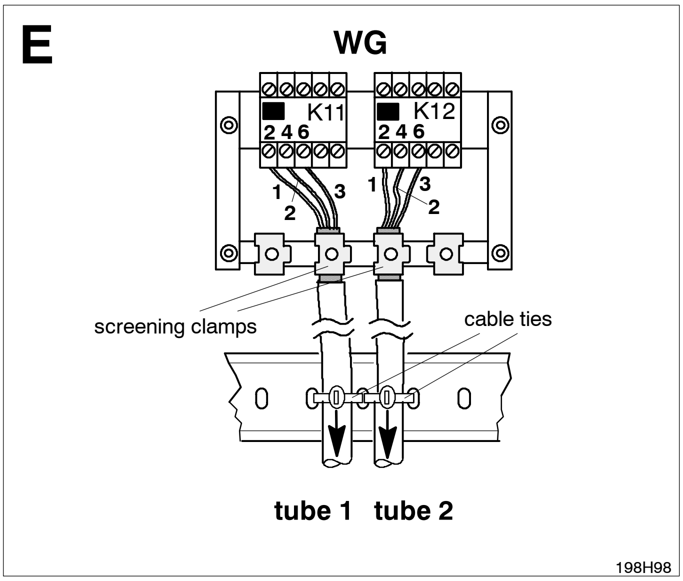
U – V	=	wire 1 – 2	=	57mH ±10%
V – W	=	wire 2 – 3	=	34mH ±10%

- Fix the screen below the screening clamp.
- Relieve the tension of the stator cable by a cable tie.

At the generator end: Two-tube version

See "Connection diagram" in section 1.

- Connect the stator cables to the terminals EWG:K11/K12.



- Check the stator connections of both tubes by measuring the resistances:

U – V	=	wire 1 – 2	≈	11Ω
U – W	=	wire 1 – 3	≈	20Ω
V – W	=	wire 2 – 3	≈	9Ω

- If an inductance meter is available, measure the following inductance values:

U – V	=	wire 1 – 2	=	57mH ±10%
V – W	=	wire 2 – 3	=	34mH ±10%

- Fix the screen below the screening clamp.
- Relieve the tension of the stator cables by cable ties.

At the generator end: Three-tube version

See ”Connection diagram” in section 1.

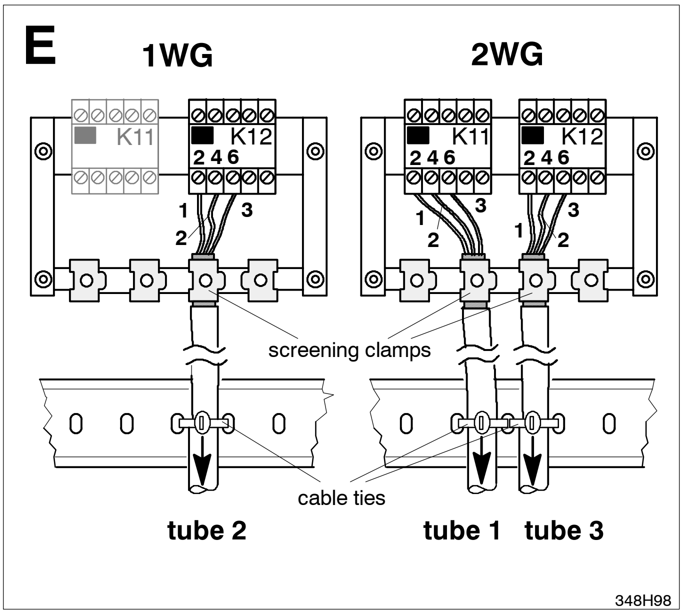
- Connect the stator cables to the terminals E1WG:K12 and E2WG:K11/K12.
- Check the stator connections of all 3 tubes by measuring the resistances:

U – V	=	wire 1 – 2	≈	11Ω
U – W	=	wire 1 – 3	≈	20Ω
V – W	=	wire 2 – 3	≈	9Ω

- If an inductance meter is available, measure the following inductance values:

U – V	=	wire 1 – 2	=	57mH ±10%
V – W	=	wire 2 – 3	=	34mH ±10%

- Fix the screens below the screening clamps.
- Relieve the tension of the stator cables by cable ties.



4.4. Signal cables

See: – ”Connection diagram” in section 1.
– Z1–6 ”Basic interface” in section “Schematic drawings”

4.4.1. Room decade cable

- Connect the door switches at the generator:

EZX1: 8 <–––> switch <–––> 10

or

EWBX22: 8 <–––> switch <–––> 10

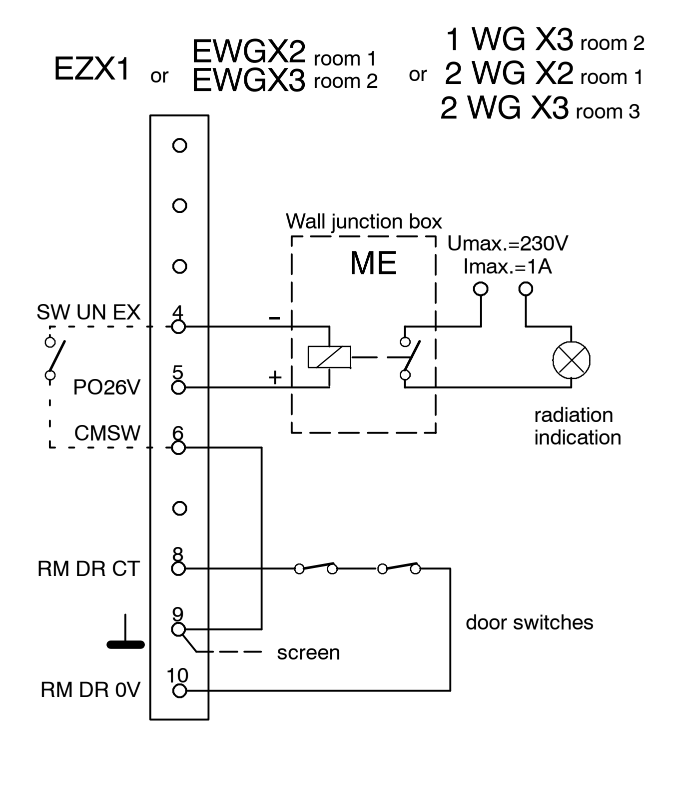
In case no switch is present
link: pin 8 <–––> pin 10

EZ150 K1:

max. switching and loading current = 1A

max. Load = 60VA AC
= 30W DC

Caution!
Make sure the polarity of the relay is correct.



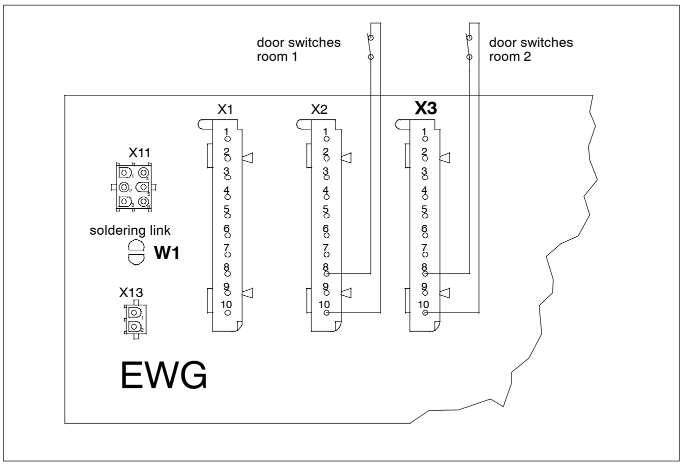
Door switch connection. 143H94

- In case of tube 2 or 3 is located in room 2 or 3 or while room decades

  - WG X3 or
  - 1WG X3 or
  - 2WG X3

  are intended to be used for room supervision the soldering link WG W1 must be placed.
  Only when this link is placed it is guaranteed that relay WG K3 pulls up and room decade WG X3 is activated when switch-over of the tube takes place.

  See Z1-14.xx "Tube extension".



- If needed connect an external relay for each examination room to control external radiation warning devices.

  One relay inclusive cable is part of delivery,
  Additional ones can be ordered: 4512 100 4523.

  A mounting place is reserved on the mains connection terminal MEX of the wall junction box.

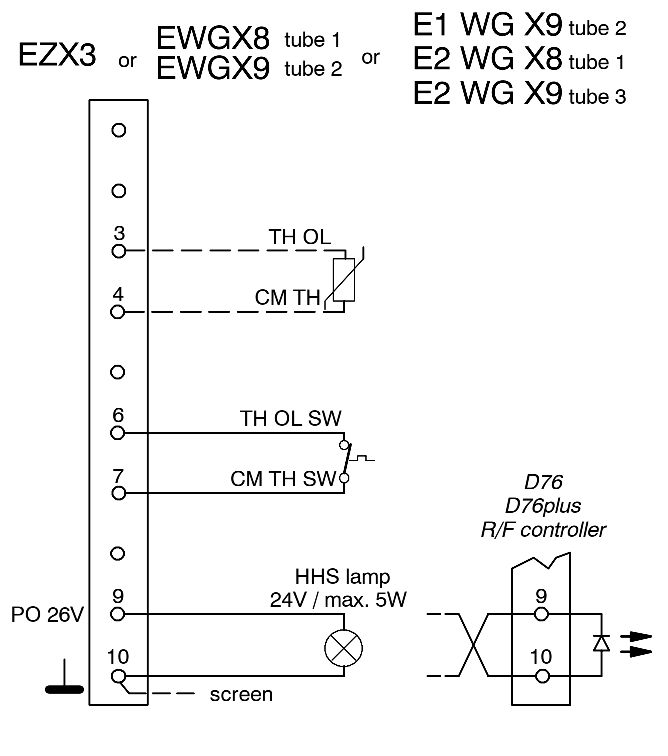
  Caution!
  Make sure the polarity of the relay is correct.

4.4.2. Tube supervision

- Connect the thermal switch or the thermal sensor of the tube housing assembly.
- Check polarity of contacts 9 and 10 to CAN adapter to remote systems like D96.

For U.S.A. and U.K. only:

- Connect the HHS-lamp to indicate the selected tube housing assembly.



Tube supervision connection.

4.4.3. CAN interface

Only for examination units which are provided with a CAN system interface.

- Connect the following plugs:

System	Connector		
	EZX23 signal bus	EZX42 or EZX42-1 system CAN	EZX43 or EZX43-1 system CAN
BukyDiagnost TH / TH2	X		X
DigitalDiagnost	X	X	X
Thoravision	X	X	X
EasyDiagnost with Bucky unit	X	X	X

4.4.4. Adapter for 4 auxiliary units

Adapter for 4 auxiliary units RAD (Bucky, Tomo) WA / 1WA / 2WA

Used for Bucky examination units which provide their control signals individually via decade cables.

Each of the release circuits and the Bucky decades can be assigned to one or several of the RGDV buttons 1...8 via software programming.

Survey: ”Connection diagram” in section 1

Z1-1.2 ”Block diagram Expansions” in “Schematic drawings” section

Detail: Z1-15.1 ”Adapter 4 aux. units WA / 1WA / 2WA” in “Schematic drawings” section

It provides:

1. 4 release decades to be used for
   - grid / syncmaster auxiliaries
   - HHS cassette present interlock

2. 2 Bucky decades to be used for
   - format size contacts (collimator, side fields ON/OFF)
   - Bucky-tomo remote switch-over
   - tomo ready condition
   - Bucky ready condition
   - HHS cassette present interlock
     to be activated by SW programming (see chapter 8.2)

   After activation via SW: Signals not provided by the system must be simulated by jumpers.

3. 1 decade EXON signal for the system via opto coupler

4. 1 decade (output) for 8 tomo trajectories

5. 1 decade for 8 tomo time inputs

6. 1 decade for 8 external APRT
   - WA backpanel programmed as 1WA = 2 AUX + 6 APRT
   - WA backpanel programmed as 2WA = 8 APRT

7. 1 decade for PSC (**P**atient **S**ize **C**orrection)

Adapter for 4 auxiliary units R/F (Fluoro, Bucky) WB

Used for fluoroscopy and Bucky examination units which provide their control signals individually via decade cables.

Each of the release circuits and the Bucky decades can be assigned to one or several of the RGDV buttons 1...8 via software programming.

Survey: ”Connection diagram” in section 1

Z1-1.2 ”Block diagram Expansions” in “Schematic drawings” section

Detail: Z1-15.2 ”Adapter 4 aux. units WB” in “Schematic drawings” section

It provides:

1. 4 release decades to be used for
   - grid / syncmaster auxiliaries
   - HSS cassette present interlock

2. 1 Bucky decade to be used for
   - format size contacts (collimator, side fields ON/OFF)
   - Bucky system ready condition

3. 1 fluoroscopy decade supporting
   - dose rate limiter (short SID)
   - lock-in

4. 1 decade EXON signal for the system via opto coupler

5. 1 decade cassette / camera remote switch-over

6. 1 decade for image intensifier and Scopomat measuring chamber formats

7. 1 system decade providing external signals
   - generator ready display
   - prep or fluoro display
   - 5 minute fluoro warning display / buzzer
   - under exposure display
   - system reset for under-exposure / 5min buzzer
   - EXON signal for the system (potential free relay contact)
   - door contact

8. 1 decade for 8 external APRT

9. 1 decade for PSC (**P**atient **S**ize **C**orrection)

4.4.5. Dose inputs

- Connect the measuring chambers to the D-Sub connectors EZX21 / 22 / 31 / 32 / 41.

  There are no assignement restrictions because the measuring chambers are allocated to the auxiliaries in SW programming.

- Withdraw pins 101-102-103 or A-D-H for measuring field selection at the junior / extremity measuring chamber.

  These measuring chambers have only one measuring field. The terminal for the left-hand field is used in other configurations for switching over intensification and must not be connected here.

- Connect the photosensor dose output of DSI from Central Part E (BHX 12) to EZX41.
  Only EZX41 sends the necessary signal REL (or REL_CH = RELease CHamber) for automatic and non-automatic techniques.

Note
*AMPLIMAT cables 9803 507 0xx02 (for hybrid measuring chambers 9803 509 xxxxx) with 3-Plus plugs at both ends **must** be connected in the generator by the following adapter for each cable:*

Adapter for AMPLIMAT cable: 4512 108 09042. The generator includes 1 adapter.

The hybrid measuring chambers 9803 509 xxxxx require connection (chassis) between contacts

D-Sub end GND (13) <---> RF 0V (8) (generator input)

or

3-Plus end GND (N) <---> RF 0V (J) (generator input)

This connection is established by the adapter for the AMPLIMAT cable.
See Z1-6 "Basic interface" in section "Schematic drawings" of the generator manual.

In case of a hybrid measuring chamber 9803 509 xxxxx is **not** operated with the required

AMPLIMAT cables . . . . . 3-Plus / 3-Plus 9803 507 0xx02

but with

AMPLIMAT cables . . . . . D-Sub / 3-Plus 9890 000 017xx

make sure to establish this connection (13 <---> 8) in the D-Sub connector!

For ALC measuring chambers 9890 000 016xx connection GND <---> RF 0V is not permitted.
Therefore, ALC measuring chambers AMPLIMAT cables 9890 000 017xx should always be used.

4.4.6. Patient Data Organizer PDO (option)

See operator's manual Patient Data Organizer.

4.5. H.V. cables generator side

See "Connection diagram" in section 1.

- Mark the H.V. cables at the generator and the tube end with the correct polarity.
- Fix the H.V. cables on the left-hand side of the wall junction box on the middle rail to provide drag relief for the cables. The short ends of the H.V. cables which are going to the H.V. generator must be routed in downward direction in this area.
  The free cable lengths including plugs should be about 1.5m.
- Twist the H.V. cables counter-clockwise by one turn and connect them to the H.V. generator.
  The twisting of the cables allows that the H.V. cables can be put into a loop when the cabinet is placed against the wall.

  The H.V. sockets should always be filled with some oil. At least the lower half of the plugs must be wet with oil.

Caution!

Do not use a silicone washer.

Do not grease the plugs with silicone.

The union nuts of the high-voltage connectors must be tightened up to ensure good electrical contact for screening.

Only high-voltage connectors which have threaded flange halves may be used.
Older high-voltage cables still have connectors where the flange halves are kept together with a spring washer.
In such cases the modification kit 4512 103 8085x is required.

4.6. Emergency-OFF circuit

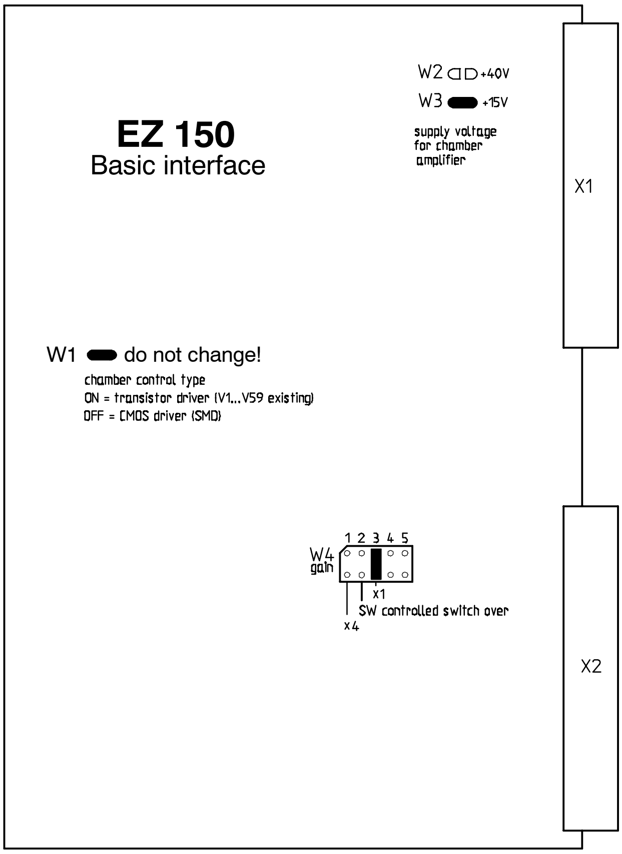
- Connect the emergency-OFF buttons to EZX4:1/2.
  If not necessary, link pins 1 - 2.

  See Z1-2.1 "Power supply" in "Schematic drawings" section and Z2-5.2 "Backpanel Basic rack-2Z" in the "Wiring diagrams" section.

5. Hardware programming

Programmings on PCB EZ150 basic interface:

Note
Never change jumper W1.



PCB layout print different from figure.

195H96

- Voltage supply for the amplifiers of connected measuring chambers:

Voltage\Soldering link	EZ 150 W2	EZ 150 W3
15V default	OFF	ON
40V	ON	OFF

Working voltage range for ALC measuring chambers: 15 ... 45V

Working voltage range for hybrid measuring chambers: 40 ... 45V

ALC measuring chambers can be recognized by the code No. 4512 104 xxxxx.

Hybrid measuring chambers are based on code No. 4512 102/103 xxxxx.

- Set the gain factor for AEC techniques with jumper EZ150:W4:
  - Factor 1 ==> W4 in position 3 = default
    For screen/film combination with at least one system speed ≤ 200.
  - Factor 4 ==> W4 in position 1
    For screen/film combinations with all system speeds > 200.

- The software programming has to be set accordingly.

The rest of the generator hardware has been properly programmed at the factory.

If required, refer to section 5: PROGRAMMINGS.

6. Switch-ON of the generator

- Switch ON the fuses present at the clinic.
- Switch ON automatic circuit-breakers ENF1, ENF2 and ENF3.

  The yellow LED on EN100 power ON circuit must be illuminated.

7. Installation software XRGSCOPE

7.1. PC and generator settings to avoid problems during up/downloading of CU complete files

Optimus R/F release 2.x and 3.x CMOS data are up/downloaded in one string without handshake.

Any kind of interruption can cause the loading process to fail.

Problems occur mainly during the download to the PC.

A download file which is not complete cannot be used as a safety backup file.

7.1.1. Preparation of the service PC to guarantee a safe loading process

Start XRGSCOPE always from DOS if possible.

When using any WINDOWS version:

- Switch OFF all screensavers.
- Do not run other programs.
- Do not insert any CD in the drive.

Any kind of power management of the PC hardware (BIOS) as well as the windows power management should be switched OFF.
If connected to mains power some of these might be automatically OFF.

7.1.2. Preparation of the generator

<u>Preparation of generators without a CAN interface:</u>

- Switch ON the generator.
  The loading process can be started once relay ENK1 has been energized.

Preparation of generators which are connected via a CAN interface:

- BuckyDiagnost TH and TH2
- DigitalDiagnost
- Thoravision
- EasyDiagnost with Bucky unit

- Switch OFF the generator.
- Disconnect the following plugs:

System	Connector		
	EZX23 signal bus	EZX42 or EZX42-1 system CAN	EZX43 or EZX43-1 system CAN
BukyDiagnost TH / TH2	X		X
DigitalDiagnost	X	X	X
Thoravision	X	X	X
EasyDiagnost with Bucky unit	X	X	X

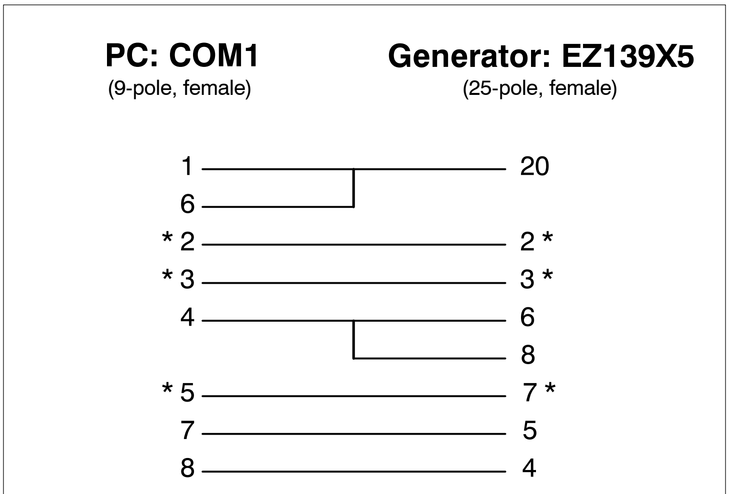
- Switch ON the generator.

Note
The download procedure must not be started before relay ENK1 has been energized at least 2 minutes after the generator has been switched ON.

Note
In case of mailing CU complete download files or any other xxx.TDL files use a zipped file format.
These files are ASCII files which might be destroyed while being mailed.

7.2. Installation procedure

- Provide the service PC with the hardware key and switch it ON.
  The hardware key provides access to special program settings and to menu ***"Faultfind".***
  Standard programming is possible without a hardware key.
- Connect the PC to X5 on EZ139 CENTRAL UNIT CU via a serial data cable:
  (A 5m long data cable can be ordered via 12NC: 4512 130 56931)



* = sufficient for communication RAD / RF

- Insert the floppy disks containing the self-unpacking exe-files of the firmware in the disk drive of the PC:
  - OMA : 4512 116 022xx
  - OMB : 4512 116 023xx

  For unpacking on the harddisk of the PC about 5MB are needed.
- Generate a directory e.g. [C:\OPT_R_35] on the PC by typing **<md C:\OPT_R_35>** or use WIN commands.
- Copy the firmware from both floppy disks to the PC into the same directory C:\OPT_R_35 by typing **<copy A:*.* C:\OPT_R_35>** or use WIN commands.
- Start unpacking the programs by typing **<OMAxxxxx.exe>** and **<OMBxxxxx.exe>** or doubleclick on **<*.exe>** –files.
  The programs unpack all files needed for the update of the firmware and the newest service tools.
- After unpacking [OMAxxxxx.exe] and [OMBxxxxx.exe] can be deleted on the harddisk by typing **<del OMAxxxxx.exe>** and **<del OMBxxxxx.exe>**.
- For the current contents of [OMA/OMBxxxxx.exe] read [OMA/OMBxxxxx.txt] on the floppy disks.
- For a new installation of the generator firmware see section 4 REPLACEMENT, chapter 3 "Exchange of firmware ...".
- Call the installation program by typing ***<xrgscope>*** or ***<xrgscope lcd>*** for PCs with LCD screen.

- Start with a XRGSCOPE-screen CUSTOMER.tdl with data which are actually stored in CUSTOMER.tdl. Type "XRGSCOPE customer"
  Whenever data screens like *'error log index'* are saved to a xxx.TDL file (function **save <F3>** appears in the bottom line), *'customer data'* being saved in the CUSTOMER.tdl file are attached to the saved data screen. It helps to separate saved screen files of different sites, customers or rooms in the same hospital.
  Site data must be stored in CUSTOMER.tdl file, only data of this file are attached to the saved screens. One can save site specific customer data in self-made files using **<F3>**. To recall site data use the **load <F4>** function.

  Procedure:
  Either the CUSTOMER.tdl screen is open or open the *'Customer Data'* screen. Push **<F4>** and select a site data file. The old data screen comes up. Now save this screen with **<F3>** typing in CUSTOMER as file name.

  - **Customer Name:**
  - **City / State:**
  - **Country:**
  - **Generator Location:**
  - **Generator Serial Number:**
  - **Generator 12 NC:**
  - **Memo1:**
  - **Memo2:**
  - **Memo3:**

  After <**ESC**> the following menu line appears:

File	***OPTIMUS***	***Select Unit***	***Options***	***Help***

- Select "OPTIMUS".

  The following menu line appears:

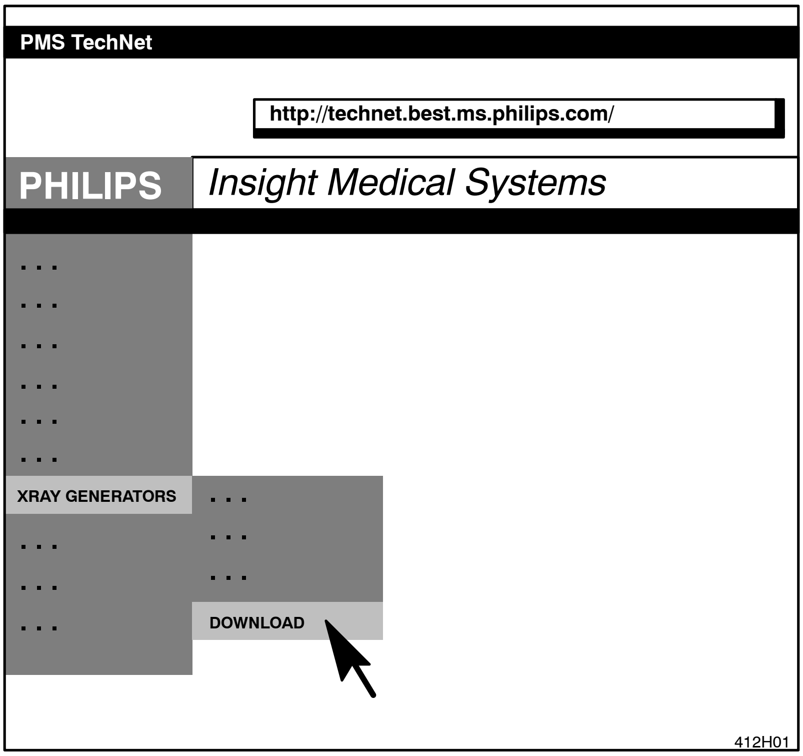
Program	***Adjust***	***Accept***	***Faultfind***	***Quit***

General information:

- Button **<F1>** **<help>** Call help / cancel help.
- Button **<F2>** **<transmit>** Store screen contents / data set in the generator ==> transmit to generator.
- Button **<F3>** **<save>** Store data screen on disk.
  For an open data screen the path desired can be selected.
- Button **<F4>** **<load>** Load data set from disk. The desired path can be selected.
- Button **<ESC>** Commands one step back. Can be used repeatedly.
- Fields with ↓ Select the possible range of values by pushing **<RETURN>**.
  The data are specified by the generator as fixed values.
- Fields with **[...]** Input of data via the keyboard.

Error numbers which appear at the beginning of the programming procedure must be erased from the screen by pushing the **<RETURN>** key.

Current data files, for instance, for online help, tube types, APR programming are available in the PHILIPS-Intranet. Use path: ***http://technet.best.ms.philips.com/*** and pull down menu as shown below.



If the installation program is called with **<xrgscope ?>** the possible starting parameters for the service program are listed.

8. Setting-to-work overview

Note
The programming of a generator must take place in the sequence specified below.

As long as no tube or RGDV has been assigned there is no display at all on the desk except “PHILIPS OPTIMUS”.

8.1. Configuration

8.2. Registration devices
- RESET the generator

8.3. Tube adjustment
- RESET the generator

8.4. Dose rate control
- RESET the generator

8.5. Application limits
- RESET the generator

8.6. Human interface
- RESET the generator

8.7. Option: Tomo Density Control TDC

8.8. Option: VARIOFOCUS

8.9. Option: Area Dose Calculator

8.10. Acceptance test

8.11. Interlock facility for APR modification

8.12. Backup of all configuration data

8.1. Configuration

- Switch the generator ON.

8.1.1. Date and time

- Select menu:
  PROGRAM/ **DATE AND TIME**
- Enter the respective local data.

8.1.2. Mains data

- Select menu:
  PROGRAM/ **MAINS DATA**

- Select the nominal value of the mains voltage U.
  Range: 380V, 400V, 440V, 480V
  Default: 400V
  If 460V is present program 480V.
  If 415V is present program 400V.
- Enter the maximum internal mains resistance R_i.
  Range: 0 ... 500mΩ

Depending on the internal mains resistance and the mains voltage the generator calculates the maximum possible output.

8.1.3. Tubes

Note
Generators which are connected by a CAN interface have to be prepared as described below.

Preparation for:
- BuckyDiagnost TH and TH2
- DigitalDiagnost
- Thoravision
- EasyDiagnost with Bucky unit

- Disconnect the following plugs:

System	Connector		
	EZX23 signal bus	EZX42 or EZX42-1 system CAN	EZX43 or EZX43-1 system CAN
BukyDiagnost TH / TH2	X		X
DigitalDiagnost	X	X	X
Thoravision	X	X	X
EasyDiagnost with Bucky unit	X	X	X

- Switch ON the generator.

Note
The download procedure must not be started before relay ENK1 has been energized at least 2 minutes after the generator has been switched ON.

Do not care if the generator is not programmed yet.

8.1.3.1. Tube data set

- Select menu:
  PROGRAM/ TUBES/TUBE 1 ... 3/ **TUBE 1 ... 3 DATA SET**
- Start the displayed file *TUBExxx.tdl* with **<RETURN>**.
  All the permitted combinations of tube type and housing type are listed in a window.
- Select the respective combination of tube type and housing type from the list and push **<RETURN>**.
- RESET the generator.
  Then the data which have been configured up to now are read by the processor when the system is started.

8.1.3.2. Tube speed selection

Depending on the type of tube loaded the anode speed is automatically programmed.

Caution!
Wrong programming can cause tube problems.

- Select menu:
  PROGRAM/ TUBES/TUBE 1 ... 3/ **TUBE 1 ... 3 SPEED SELECTION**

RPM \ tube type	RO	SRO
Exposure rotation [RPM]	3000	9000
Fast exposure rotation [RPM]	n/a	n/a
Fluoroscopy rotation [RPM]	3000	3000

8.1.3.3. Tube limits

- Select menu:
  PROGRAM/ TUBES/ **TUBE LIMITS**
- Program the maximum working voltage which is indicated on the data label:

  Max. tube voltage limit
  Range: 40 ... 150kV
  Default: 150kV

  Adaptation of the tube takes place only up to this limit.

Note
If older tubes are to be operated on this generator, it is urgently recommended that the max. kV used in practical operation so far be specified instead of the theoretically possible value.
The max. kV value should be determined during the conditioning procedure as described in chapter 8.3.1.

After adaptation of a tube the upper kV limit is displayed for each focus of each tube under:
Adapted to [kV]: e.g. 125kV

All the other limit programmings are performed by the generator automatically and do not usually have to be observed.

8.1.3.4. Capacitance of tube connection

- Select menu:
  PROGRAM/ TUBES/ **CAPACITANCE TUBE CONNECTOR**

  Range: 2.000 ... 10.000nF

  The total capacitance for each tube connected is indicated:

  $C = \frac{1}{2} \left(C_{H.V.\ generator} + C_{H.V.\ cable}\right)$

  $= 4.550nF$ Default for H.V. generator + 20m H.V. cable (155pF/m)

  $$C\ [nF] = 3 + \frac{C_c \times L}{2000}$$

  C_c = specific cable capacitance in [pF/m]
  L = single cable length in [m]

Single length [m]	Capacitance tube connection [nF]	
	For 155pF/m cable	For 200pF/m cable
14	4.085	4.400
16	4.240	4.600
18	4.395	4.800
20	4.550	5.000
22	4.705	5.200
24	4.860	–
26	5.015	–
28	5.170	–
30	5.325	–

The high-voltage cables type 9806 402 6xx02 currently being supplied have a capacitance of 155pF/m.

8.1.3.5. Tube operating modes

- Select menu:
  PROGRAM/ TUBES/ **TUBE OPERATING MODE**

  - Intermediate boost:

Select ...	Disable	=	During preparation the rated filament current is applied (default).
	Enable	=	During preparation a reduced filament current is applied. After the release of exposure boosting takes place for a short time before the exposure is released. Effective with tube currents > 80% of max. value.

  - Rotation prolongation after PREP:

Select ...	Disable	=	The tube is braked as soon as preparation has been cancelled.
	Enable	=	After cancellation of preparation the tube is only braked after 30s. Within this time preparation can be repeated as often as necessary. Recommended for paediatrics and casualty rooms. The enable mode works with high speed rotor control unit only.

8.1.3.6. Disable tube

For correction of the configuration.

- Select menu:
  PROGRAM/ TUBES/ **DISABLE TUBE**

When the tube is disabled the above stored data set of the tube is erased. To enable the tube the data set has to be loaded again.

8.2. Registration devices

8.2.1. Data set A ... B

- Select menu:
  PROGRAM/ REGISTRATION DEVICES/ RGDV 1 ... 8/ **DATA SET A ... B**

- Program the data set A and B of RGDV 1 ... 8 for all exam. / aux. units desired.

Data set A

Room:
Room number of the exam. / aux. unit for room decade (radiation warning display and door contact).

Tube:
Tube assignment for the exam. / aux. unit.

Release circuit number:
Number of the release decade of the release circuit adaptation unit WA, WB programmed (e.g.: 1 for X1 etc., see Z1-1.2).

Enable handswitch at generator desk:

Programming	Enable release switch at generator desk	Enable external release switch [1]
NO		X
YES	X	
	X	X

Syncmaster present:
NO = Free cassette (without cassette present interlock)
YES = - Bucky or tomo synchronous contact [2]
- WA/WB 4:1-2 (20/21)

Exposure switch type:
Single step = Exposure request instantly with preparation [1]
Double step = Individual preparation request and exposure request

Bucky format density correction:
Density correction in steps of 6%. Range: -8 ... +8
Correction during collimation, input at WAX11/12 pin 1-2 or WBX11 pin 1-2, side fields active when contact closed (<24x24cm), center field only when opened.
With GALILEO or NICOL collimator via Bucky controller with CAN.

Cone density correction:
Density correction in steps of 6%. Range: -8 ... +8
Input at WBX13 pin 4-5.
Valid only when the assigned cone contact is closed.

Dose measurement input:
Measuring chamber respectively at input EZX 21, 22, 31, 32, 41
none = No measuring chamber assigned.
For free cassette or tomography without TDC.

1) For this function the WA/WB option is required.
Ignore for RGDV with CAN: BuckyDiagnost TH/TH2, Thoravision, DigitalDiagnost, EasyDiagnost with Bucky unit.

2) All RGDV with CAN: BuckyDiagnost TH/TH2, Thoravision, DigitalDiagnost, EasyDiagnost with Bucky unit.

Data set A continued:

Dose measurement sensor type:

Bucky AMPLIMAT: Input via EZX21/22/31/32/41, measuring field selection on control desk possible.

Scopo AMPLIMAT: Input via EZX21/22/31/32/41,only center field displayed on the control desk. It has to be programmed in case of a "Junior Diagnost" or "Extremities" measuring chamber to prevent from side field selection.

Photo sensor: Input via EZX61, if "none" is programmed at "dose measurement input", in this case the exposure ON signal has to be connected to the central part via signal bus.

Photo sensor / AMPLIMAT input: Photo sensor input via EZX21/22/31/32/41.
Only EZX41 supports DSI exposure series with non AEC techniques.

Exposure series / Tomo movement:	NO	=	Instant brake after exposure end.
	NO	=	To be programmed for tomo systems via system CAN. BuckyDiagnost TH/TH2, DigitalDiagnost, EasyDiagnost with Bucky unit
	YES	=	More than one exposure possible with one PREP. - For tomo units released by 1WA/2WA, PREP must be kept active at the release decade to get the tomo stand back to the start position. - DSI or multiple exposures for SCOPO.

Release delay (automatic techniques):	enable =	Must be enabled for all AEC techniques. Automatically disabled if non AEC techniques selected.
	disable =	Not to be programmed. Keep release delay always on enable.

Data set A continued:

Mounted radiographical controller:

none	=	Must be programmed if any release circuit adaptation unit 1WA, 2WA, 1WB is assigned to this RGDV. No CAN controlled system is assigned to this RGDV.
Bucky controller 1 / DigitalDiagnost	=	CAN controlled system - BuckyDiagnost TH/TH2, DigitalDiagnost RGDV1 ... 4 only - EasyDiagnost with Bucky controller RGDV5 ... 8 only
Bucky controller 2	=	No function yet.
Thoravision	=	Can controlled system - Thoravision RGDV1 only

Release circuit adaptation unit:	Assignment of the release unit 1WA, 2WA, 1WB		
	none	=	free cassette or in case of a CAN driven examination unit
Mounted tomo extension:	none	=	no tomo unit installed
	1WA	=	(1)WAX21 valid as tomography time input
	2WA	=	2WAX21 valid as tomography time input

Medium II format kV corr. (dose equiv. steps):	Range = 0...8 dose equiv. + kV correction steps
Medium II format density corr. (-6% steps):	Range = 0...8 -6% density steps
Medium II format mAs corr. (-6% steps):	Range = 0...8 -6% mAs steps
Small II format kV corr. (dose equiv. steps):	Range = 0...8 dose equiv. + kV correction steps
Small II format density corr. (-6% steps):	Range = 0...8 -6% density steps
Small II format mAs corr. (-6% steps):	Range = 0...8 -6% mAs steps

An RGDV must not be assigned to a ”mounted radiographical controller” and a ”release circuit adaptation unit” together.

Data Set B (underlined items = default)			
Used for tomo:	NO		
	YES	=	With YES a definition of the tomography time is expected from the examination unit, e.g. via WAX21 or from a Bucky controller with tomo.
Used for fluoroscopy:	NO	=	Ok
	YES	=	Fluoro unit
CT add on:	NO	=	Ok (No function available yet)
Disable time override:	NO		
	YES	=	Disables time override function at desk. Automatically disabled with ”Used for tomo = YES”.
Tube power factor:			1 ... 100%
kV steps:			Single = kV-grading in steps of 1kV Dose equivalent = 6% kV steps ≙ 25% density steps
mA steps:			step width in 25, 12 or 6%
Time steps:			exposure time step width in 25, 12 or 6%
Density steps:			step width in 25, 12 or 6%
Density correction (6% steps):			-8 ... 0 ... +8 correction steps For correction see chapter 13.
Underexposure display (non-automatic techniques):	YES	=	Underexposure is also indicated with techniques without AMPLIMAT.
	YES	=	To be programmed for tomo systems via system CAN: BuckyDiagnost TH/TH2, DigitalDiagnost EasyDiagnost with Bucky unit.
	NO	=	Must be set for all non-CAN tomo systems.
Tube overload protection:	ON	=	Overload protection active (default): red = no PREP possible
	OFF	=	Exposures are possible irrespective of load status. Must not be programmed.

desk display	tube load
green	100%
green - yellow	100%
yellow	80%
yellow - red	64%
red	0%

8.2.2. Interface assignment

- Select menu:
  PROGRAM/ REGISTRATION DEVICES/ RGDV INTERFACE ASSIGNMENT/ **BUCKY/TOMO 1WA...2WA**

Note
There must be no programming here if the diagnostic unit is connected via the CAN interface: BuckyDiagnost TH/TH2, Thoravision, DigitalDiagnost, EasyDiagnost with Bucky unit.

- Assign the format and ready contacts of the decade connector WAX11 or WAX12 to a Bucky or tomography RGDV. Refer to Z1-15.1.

  - Decade Bucky 1 (X11) See following table.
  - Decade Bucky 2 (X12) Program the functions as for the first Bucky decade.
  - Tomo Time 0.1 ... 6000ms for each trajectory.

  One tomography unit can be programmed for each device interface.

Decade Bucky 1 ... 2			
Tomo mode switch:	disable	=	Input ”tomo mode” is not activated. Remote changeover Bucky / tomography not possible via the examination unit.
	enable	=	Input ”tomo mode” is activated. Remote changeover Bucky / tomography possible. Bucky and tomo RGDV must be defined.
Bucky RGDV – switch related:	none/ RGDV 1 ... 8 The inputs ”format contacts” and ”Bucky ready” are activated. When the tomo mode switch is enabled, this RGDV is activated when the remote tomo mode switch is open.		
Bucky RGDV:	none/RGDV 1 ... 8 The inputs ”format contacts” and ”Bucky ready” can be assigned to any RGDV button. The inputs ”format contacts” and ”tomo ready” are activated.		
Tomo RGDV – switch related:	none/ RGDV 1 ... 8 When the tomo mode switch is enabled, this RGDV is activated when the remote tomo mode switch is closed.		

- Select menu:
  PROGRAM/ REGISTRATION DEVICES/ RGDV INTERFACE ASSIGNMENT/ BUCKY/ ***SCOPOMAT 1WB***

  Bucky RGDV: none or
  RGDV 1 ... 8 activates inputs at WBX 11 for RGDV:
  - X11 : 9 – 10 R/F controller ready-closed.
  - X11 : 1 – 2 Format size correction contact (Bucky chambers only).

- RESET the generator.

- Fill in the program settings in table “RGDV programming” 2Z–2.0 at the end of this section.

8.2.3. Examples for RGDV programming

Example No.	System	Refer drawing
1	- Diagnost 76: Exposure Scopo / BV-DSI - Bucky wall stand - Free cassette	2Z-2.1
2	- BuckyDiagnost TH with Bucky controller - Diagnost 76: Exposure Scopo / BV-DSI	2Z-2.2
3	- Diagnost 96: Cassette + DSI with / without tomo - Bucky wall stand - Free cassette	2Z-2.3
4	- HDH with / without tomo time input - Bucky wall stand - Free cassette	2Z-2.4
5	- BuckyDiagnost TH/TH2, Digital Diagnost with Bucky controller and CAN interface - Bucky wall stand - Free cassette	2Z-2.5
6	- BuckyDiagnost TS - Bucky wall stand - Free cassette	2Z-2.6
7	- EasyDiagnost: Exposure Scopo / BV-DSI - CAN controlled CS Bucky unit - Bucky wall stand - Free cassette	2Z-2.7
8	- Bucky TH any version with Bucky controller - Generator equipped with or without decade adaptation unit WA - Auxiliary for MCS (only) = RGDV4 in combination with free cassette	2Z-2.8
9	- Bucky TH any version - Generator equipped with or without decade adaptation unit WA - Auxiliary for MCS (only) = RGDV5 ... 8	2Z-2.9
10	- Bucky TH any version - Generator equipped with or without decade adaptation unit WA - Auxiliary for Trauma Diagnost (only) = RGDV5 ... 8 - Auxiliaries RGDV1 ... 4 must not be used with a Bucky TH system via CAN	2Z-2.10

8.3. Tube adjustment

8.3.1. Tube conditioning

Warning!
Radiation is released during the conditioning procedure!

8.3.1.1. Preconditions / Programmings

- Switch OFF the generator.

Preparation of generators which are connected via a CAN interface:

- BuckyDiagnost TH and TH2
- DigitalDiagnost
- Thoravision
- EasyDiagnost with Bucky unit

- Switch OFF the generator.
- Disconnect the following plugs:

System	Connector		
	EZX23 signal bus	EZX42 or EZX42-1 system CAN	EZX43 or EZX43-1 system CAN
BukyDiagnost TH / TH2	X		X
DigitalDiagnost	X	X	X
Thoravision	X	X	X
EasyDiagnost with Bucky unit	X	X	X

- Switch ON the generator.

Note
The programming procedure must not be started before relay ENK1 has been energized at least 2 minutes after the generator has been switched ON.

- Perform the following programmings temporarily for each tube connected to one of the assigned RGDV = Free cassette
  Select menu XRGSCOPE:
  PROGRAM/ REGISTRATION DEVICES/ RGDV#/ **DATA SET A**

Programming	Temporarily	Original Tube
Enable handswitch	YES	Verify the customized entries in 2Z-2.x
Syncmaster present	NO	
Exposure switch type	Double Step	
Exposure series / Tomo	YES	
Mounted radiographic	NONE	

- RESET the generator.
- Select appropriate programmed RGDV = “Free cassette” for the tube to be conditioned.

8.3.1.2. Procedure

- Select **large** focus only.

Note
The generator must be in the READY *state.*

- Run reconditioning procedure for an adapted tube, refer to following table, left column TUBE ADAPTED.

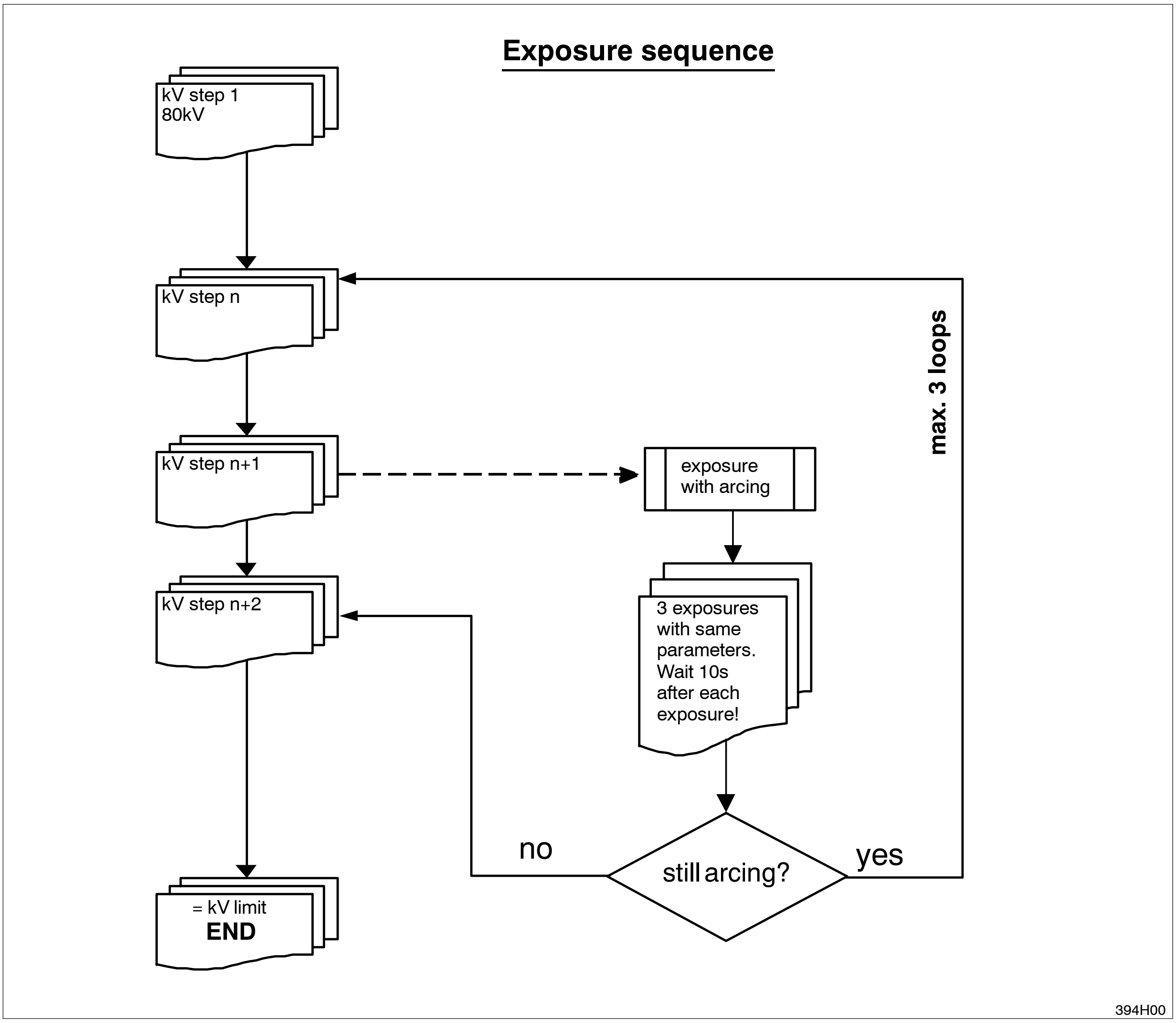
or

- Run conditioning procedure for a new or non-adapted tube, refer to following table right column TUBE NOT ADAPTED.
- It is recommended that the high tension be monitored during conditioning.
  Connect the scope:
  Channel1: kV AV HT at EZ130 X3 (1V/div), scale: 20kV/V
  Trigger external: CTRL_X_C/ at backpanel EZ X74, negative slope
  Time base: 2ms/div
- In case of problems like tube arcing see the following flowchart EXPOSURE SEQUENCE as an example.
  The flowchart applies for applicable kV range only, e. g.:
  109kV is the max. kV value for normal application, perform just up to next higher kV step = 117kV.

Note
Refer to flowchart EXPOSURE SEQUENCE.
If the tube arcs at a certain kV value, switch another 3 exposures with same parameters and 10s pause between subsequent exposures. In case of success (no arcing anymore) continue with next kV step of the following table.
If the last exposure still arcs go one kV step back and follow normal procedure. If this routine has been performed three times without improvement: ==> **Replace the tube!**

Exposure parameters for conditioning					
Tube adapted			# exposures	Tube not adapted	
kV	mA	ms		kV	mAs
80	10	50	< 1 >	80	0.5
80	10	500	< 1 >	80	5
80	200	250	< 1 >	80	50
10 seconds pause				10 seconds pause	
80	max. mA	100	< 1 >	80	100
1 minute pause				1 minute pause	
90	10	50	< 1 >	90	0.5
90	10	500	< 1 >	90	5
90	200	250	< 1 >	90	50
10 seconds pause				10 seconds pause	
90	max. mA	100	< 1 >	90	100
1 minute pause				1 minute pause	
100	10	50	< 1 >	100	0.5
100	10	500	< 1 >	100	5
100	200	250	< 1 >	100	50
10 seconds pause				10 seconds pause	
100	max. mA	100	< 1 >	100	100
1 minute pause				1 minute pause	
110	10	50	< 1 >	110	0.5
110	10	500	< 1 >	110	5
110	200	250	< 1 >	110	50
10 seconds pause				10 seconds pause	
110	max. mA	100	< 1 >	110	100
1 minute pause				1 minute pause	
120	10	50	< 1 >	120	0.5
120	10	500	< 1 >	120	5
120	200	250	< 1 >	120	50
10 seconds pause				10 seconds pause	
120	max. mA	100	< 1 >	120	100
1 minute pause				1 minute pause	
130	10	50	< 1 >	130	0.5
130	10	500	< 1 >	130	5
130	200	250	< 1 >	130	50
10 seconds pause				10 seconds pause	
130	max. mA	100	< 1 >	130	100
1 minute pause				1 minute pause	

Exposure parameters for conditioning					
Tube adapted			**# exposures**	**Tube not adapted**	
kV	**mA**	**ms**		**kV**	**mAs**
140	10	50	< 1 >	140	0.5
140	10	500	< 1 >	140	5
140	200	250	< 1 >	140	50
10 seconds pause				10 seconds pause	
140	max. mA	100	< 1 >	140	100
1 minute pause				1 minute pause	
145	10	50	< 1 >	145	0.5
145	10	500	< 1 >	145	5
145	200	250	< 1 >	145	50
10 seconds pause				10 seconds pause	
145	max. mA	100	< 1 >	145	100
1 minute pause				1 minute pause	
148	10	50	< 1 >	148	0.5
148	10	500	< 1 >	148	5
148	200	250	< 1 >	148	50
10 seconds pause				10 seconds pause	
148	max. mA	100	< 1 >	148	100
1 minute pause				1 minute pause	
150	10	50	< 1 >	150	0.5
150	10	500	< 1 >	150	5
150	200	250	< 1 >	150	50
10 seconds pause				10 seconds pause	
150	max. mA	100	< 1 >	150	100
1 minute pause				1 minute pause	



Note

If a tube arcs at any kV value which is not required for application the max. kV (e.g.117kV) program this new limit value by XRGSCOPE:
PROGRAM/ TUBES/ TUBE LIMITS/ MAX. TUBE VOLTAGE LIMIT [kV]/ **[117]**

As the limit value decreases for this reason, a following re-adaptation procedure sets the field ADAPTED TO [kV] to this value as well.

- Set RGDV programming to original status if no adaptation procedure has to be executed.
- RESET the generator.

8.3.2. Tube adaptation

Warning!
Radiation is released during the adaptation procedure!

8.3.2.1. General information

Tube adaptation is an automatic process which includes:

1. The measurement of the mA offset value that is caused by:
   - the kV measuring circuit
   - the emission current feedback circuit (VCO)

2. The measurement of the individual standby filament current (based on 100μA).

3. The emission current characteristic as f (kV, filament current).

4. The dynamic behavior (positive and negative boost adaptation) where the inertia of the filament with respect to heating up and cooling down is registered.
   For more information refer to section 3: FAULT FINDING.

Note
In case of problems check the symptom / solution list at the end of this adjustment chapter. Repeat the adaptation for this particular focus.

8.3.2.2. Preconditions / Programmings

- Switch OFF the generator.

Preparation of generators which are connected via a CAN interface:

- BuckyDiagnost TH and TH2
- DigitalDiagnost
- Thoravision
- EasyDiagnost with Bucky unit

- Switch OFF the generator.
- Disconnect the following plugs:

System	Connector		
	EZX23 **signal bus**	**EZX42 or EZX42-1 system CAN**	**EZX43 or EZX43-1 system CAN**
BukyDiagnost TH / TH2	X		X
DigitalDiagnost	X	X	X
Thoravision	X	X	X
EasyDiagnost with Bucky unit	X	X	X

- Switch ON the generator.

Note
The adaption procedure must not be started before relay ENK1 has been energized at least 2 minutes after the generator has been switched ON.

- The tube must be conditioned as described in chapter 8.3.1 “Tube conditioning”.
- Check the upper kV limit
  Select menu XRGSCOPE:
  PROGRAM/ TUBES/ TUBE LIMITS/ **MAX. TUBE VOLTAGE LIMIT [kV]**

  The programmed value should match the nominal value of the tube connected or in case of older tubes the upper kV limit should be set to the max. application kV.
  Once an adaptation is completed the new limit value indicates as ADAPTED TO [kV].

- Perform the following programmings temporarily for each tube connected to one of the assigned
  RGDV = Free cassette
  Select menu XRGSCOPE:
  PROGRAM/ REGISTRATION DEVICES/ RGDV#/ **DATA SET A**

Programming	Temporarily	Original Tube
Enable handswitch	YES	Verify the customized entries in 2Z-2.x
Syncmaster present	NO	
Exposure switch type	Double Step	
Exposure series / Tomo	YES	
Mounted radiographic	NONE	

8.3.2.3. Procedure

- RESET the generator.
- It is recommended that the high tension be monitored during adaptation.
  Connect the scope:
  Channel1: kV AV HT at EZ130 X3 (1V/div), scale: 20kV/V
  Trigger external: CTRL_X_C/ at backpanel EZ X74, negative slope
  Time base: 2ms/div
- Select the RGDV = Free cassette for the tube to be adapted.
- Select menu XRGSCOPE:
  OPTIMUS XRG/ ADJUST/ **TUBE ADAPTATION**
- Select the tube and focus to be adapted, start with small focus!

Note
To avoid any malfunction make sure that READY is displayed on the desk before transmitting data by pushing ***<F2>****:*
READY state disappears, ADAP is displayed on the desk, WAITING is displayed on the PC screen.
Wait until the generator turns back to READY state.

- Start the adaptation process by pushing the handswitch in PREP and EXP position continuously.

  The generator switches about 125 exposures for each focus. The radiation sign at the desk indicates exposures but there is no beep at the end of each exposure.
  The actual kV parameters are displayed during adaptation.

  The generator carries out the adaptation automatically. The procedure for one focus is completed when the desk indication changes from ADAP to TEST. The WAITING message disappears from the PC screen together with a PC beep, followed by the screen: BEFORE CONTINUING THE GENERATOR MUST BE RESET.
- RESET the generator.
- Run the adaptation for each focus (small and large) and tube.

Note
As there is no tube type with a physical third (middle) focus yet, the third focus can not be adapted.
VARIOFOCUS values are calculated by adapted small and large focus. APR programs using VARIOFOCUS can only be selected until small and large focus are both adapted.

- Set RGDV(s) programming to original status according to table “RGDV programming” 2Z-2.x in the end of this chapter.

8.3.3. Final tube adjustment work

1. BuckyDiagnost TH with CAN interface, DigitalDiagnost, Thoravision:

   - Switch OFF the generator.
   - Reestablish signal bus connector EZX23.
   - Reestablish CAN connectors EZX42-1 and EZX43-1.
   - Switch ON the generator.

2. All other systems:

   - Reset the generator.

8.3.4. Problems during adaptation - Symptoms and solutions

1. A warning cannot be displayed on the control desk, the WAITING screen on the PC is flickering instead during this event and logged in the error log index.

2. If the tube has already been at a high temperature level (but the tube load indication still indicates green or green-yellow for 100% power) it might happen that the load indication changes straight to red and the adaptation is on hold. WAITING is flickering on the PC.
   Solution: Keep the handswitch pushed, once the temperature is down adaptation continues automatically.

   Note
   An increment of one of the temperature levels inhibits the 100% power condition. This event is always logged as warning 00BV in the error log index.

3. An error message just flashes for a very short moment and is instantly covered by ADAP on the desk afterwards. WAITING is flickering on the PC.

4. All buttons at the control desk including the RESET button are inactive during adaptation.
   The only way to RESET an error is to release the PREP switch which causes an interrupt similar to the RESET command.

5. After letting go of the PREP switch wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.

6. If adaptation seems to do nothing for more than 30 seconds let go of the PREP switch. Wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.

7. If a constant READY indication appears for more than 2 seconds while PREP and EXP is activated by the handswitch during adaptation let go of the handswitch.
   Wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.

8. If adaptation does not carry on with or without READY indication check whether one of the function units indicates a FATAL error by turning on the red LED. Let go of the handswitch and run a warmstart of the generator by pushing the RESET button on CU EZ139.

9. If adaptation has been interrupted by a generator warmstart check the error log index before restarting adaptation:
   kV errors 02WG and/or 02WH indicate tube arcing. Run conditioning of the tube as described in chapter 8.3.1 and/or reduce the max. kV value to the required application value.

8.4. Dose rate control

8.4.1. AMPLIMAT sensitivity

- Select menu:
  PROGRAM/ DOSE RATE CONTROL AMPLIMAT/ **SENSITIVITY**

- Depending on HW programming of jumper EZ150:W4. W4 programs sensitivity accordingly:

  high = $\times$ 4 = EZ150:W4 in position 1
  ===> All screen/film combinations with a system speed > 200.

  low = $\times$ 1 = EZ150:W4 in position 3
  ===> At least one screen/film combination with a system speed $\leq$ 200.

8.4.2. Screen/film combinations

5 screen/film combinations can be programmed for each of the 5 measuring chambers:

- Select menu:
  PROGRAM/ DOSE RATE CONTROL/ AMPLIMAT CHAMBER 1 ... 5/ **DATA SET 1 ... 5**

  The number of the chamber corresponds to the specified unit number of the dose measuring unit.

The choice between automatic and manual DRC processing is possible when an authorized hardware key is inserted in the PC.

Automatic is selected as default and must be used for the initial programming.
Data sets of adjacent rooms can be copied but have to be aligned afterwards.

Access manual DRC processing by pushing the **<ESC>** key.
The manual mode is suitable for:

- Copying complete programming to other measuring chambers.
- Setting the basic density.
- Changing the desk-displayed names of the programmed screen/film combinations.
- Creating backups of the DRC programmings.

8.4.2.1. Automatic DRC processing

- Select the desired data from the files offered for the following programming steps.

  The files are part of the installation software.
  - Select the programming field with the cursor and enter **<RETURN>**.
  - Enter the desired file from the list offered.
  - Select the desired data as required.

FILM:	File **FILM.TDL**	Film types according to description of the manufacturer.
	File **FILM_BL/ _GR/ _UV.TDL**	General classification of the film according to color, sensitivity S and RLF compensation.
SCREEN:	File **SCREEN.TDL**	Screen types according to description of the manufacturer.
	File **LUMAT_LG.TDL**	- Screen types according to luminous matter. - Imaging plates.
CHAMBER:	File **CHAMBER.TDL**	Different types of measuring chambers.
CASSETTE:	File **CASSETTE.TDL**	Different types of cassettes.
SYSTEM CORRECTION:	File **SYSCOR.TDL**	Select **no corr. (ISO 9236-1)**
CORRECTION FACTOR:	Default **1.00**	Correction factor for switch-OFF dose.

Based on the combination of the components entered, the processor calculates the switch-OFF dose, kV correction and RLF compensation. The name for the screen/film combination, e.g. "B400", is taken from the "screen" default data set.

Dose Rate Control setting Optimus for Computed Radiography (PCR or other imaging plates)

The following example is for a 400 speed system, determined by the selection of the LG06 400 speed type from file LUMAT_LG.TDL (luminous groups).
Ignore the violet screen colour of LG06, the data set just requires its kV characteristic.

FILM:	File **FILM.TDL**	**X-CONSTANT RLF=1**
SCREEN:	File **LUMAT_LG.TDL**	**LG06 S400 vi**
CHAMBER:	File **CHAMBER.TDL**	*the installed chamber type*
CASSETTE:	File **CASSETTE.TDL**	**normal cassette (def)**
SYSTEM CORRECTION:	File **SYSCOR.TDL**	**no corr. (ISO9236-1)**
CORRECTION FACTOR:		**1.00**

Note
Film, screen, etc. data selected are not directly stored in the generator.
It is recommended that they be entered in the table "Data sets of chambers" 2Z-4 at the end of this section.

- RESET the generator.

Color and sensitivity class of the screen/film combination are displayed on the desk, e.g.: "B400".
Other screen/film combinations (data set 1 ... 5) for the chamber can be selected by the ± buttons.

8.4.2.2. Manual DRC processing

The current data set of the screen/film combination is displayed.

* Abbreviation:	Abbreviation for the screen/film combination. Example: B400 = blue, speedclass 400.
Dose Request Chamber:	Senstitivity of the measuring chamber type in [μGy/V].
* Dose of FSC:	Switch-OFF dose of the screen/film combination in [μGy]. Linear ratio with respect to the film density.
kV70-Char. U_0 ... 9:	Checkpoints for kV-dependent density correction.
kV70-Char. Drel_0 ... 9:	Relative correction value for the dose.
RLF t_0 ... 9:	Checkpoints for time-dependent density correction. (RLF = **R**eciprocity **L**aw **F**ailure).
RLF Drel_0 ... 9:	Relative correction value for the dose.

* = Only these fields may be changed according to the system requirements.
All other fields must not be changed.

- If required, change the data and the abbreviation name.
  Usually no value except the basic density ”Dose of FSC” must be changed (see next page).
- Transmit the data set with **<F2>**.
- RESET the generator.

The **SAVE <F3>** and **LOAD <F4>** functions of ***XRGSCOPE*** permit straightforward copying of the measuring chamber programmings.

8.4.2.3. Density correction for AEC technique (option)

Basic density per screen/film combination:

A hardware key is required at the PC for direct access to the switch-OFF dose.

- Make a test exposure for each screen/film combination.
  To do so, set the density correction = 0.
- Determine the density of the test exposures.
- Select menu:
  PROGRAM/ DOSE RATE CONTROL/ AMPLIMAT/ CHAMBER 1 ... 5/ **DATA SET 1 ... 5**

- Select manual DRC programming by pushing the **<ESC>** key.

- Correct the switch-OFF dose = “Dose of FSC” according to formular below:

$$\text{New switch-OFF dose} = \frac{\text{Desired density}}{\text{Measured density}} \times \text{Old switch-OFF dose}$$

- Transmit the data set by pushing the **<F2>** key.
- Repeat the procedure for each screen/film combination at each chamber.
- RESET the generator.

The switch-OFF dose can be set on the PC even without a hardware key.
To do so, call up the automatic DRC programming, repeat all the selections and change the correction factor for switch-OFF dose accordingly. Each time this programming is called up all the selections must be repeated.

8.4.3. Image intensifier (II)

- II lead time
- Density voltage correction: Default = 1V
- Dynamic factors

At auxiliaries which are using DSI tomo with TDC (**T**omo **D**ensity **C**ontrol) take care that the following settings are present to get a linear density voltage of 1V.

- Select menu:
  PROGRAM/ REGISTRATION DEVICES/ RGDV x/ **DATA SET A**

Dose measurement input: **EZX41**

Dose measurement sensor type: . . . . . . Photo sensor / Amplimat input

- Select menu:
  PROGRAM/ DOSE RATE CONTROL/ AMPLIMAT/ CHAMBER **5**/ **DATA SET 1**

- Press <**ESC**> button.

Checkpoint	Correction factor	Remark
Abbreviation	[def1] Δ	Δ **Note** *Do not care about these correction factors.*
Dose Request Chamber [μGy/V]	[6.40] Δ	
Dose of FSC [μGy]	[2.14] Δ	
kV70-Char. U_0 [kV]	[40]	* **Note** *These fields of the kV dependent correction factors must always be 1.00.*
kV70-Char. Drel_0	[**1.00**] *	
kV70-Char. U_1 [kV]	[40]	
kV70-Char. Drel_1	[**1.00**] *	
kV70-Char. U_2 [kV]	[50]	
kV70-Char. Drel_2	[**1.00**] *	
kV70-Char. U_3 [kV]	[60]	
kV70-Char. Drel_3	[**1.00**] *	
kV70-Char. U_4 [kV]	[70]	
kV70-Char. Drel_4	[**1.00**] *	
kV70-Char. U_5 [kV]	[80]	
kV70-Char. Drel_5	[**1.00**] *	
kV70-Char. U_6 [kV]	[90]	
kV70-Char. Drel_6	[**1.00**] *	
kV70-Char. U_7 [kV]	[110]	
kV70-Char. Drel_7	[**1.00**] *	
kV70-Char. U_8 [kV]	[130]	
kV70-Char. Drel_8	[**1.00**] *	
kV70-Char. U_9 [kV]	[150]	
kV70-Char. Drel_9	[**1.00**] *	

Checkpoint	Correction factor	Remark
RLF t_0 [ms]	[0] Δ	
RLF Drel_0	1.000] Δ	
RLF t_1 [ms]	[20] Δ	
RLF Drel_1	[1.000] Δ	
RLF t_2 [ms]	[60] Δ	
RLF Drel_2	[1.000] Δ	
RLF t_3 [ms]	[100] Δ	
RLF Drel_3	[1.000] Δ	
RLF t_4 [ms]	[500] Δ	Δ **Note** *Do not care about these RLF correction factors.*
RLF Drel_4	[1.000] Δ	
RLF t_5 [ms]	[1000] Δ	
RLF Drel_5	[1.000] Δ	
RLF t_6 [ms]	[1500] Δ	
RLF Drel_6	[1.000] Δ	
RLF t_7 [ms]	[2000] Δ	
RLF Drel_7	[1.000] Δ	
RLF t_8 [ms]	[3000] Δ	
RLF Drel_8	[1.000] Δ	
RLF t_9 [ms]	[4000] Δ	
RLF Drel_9	[1.000] Δ	

8.4.4. Fault exposure detection

Fault exposure detection is switched ON as a default for AEC and TDC. If in the initial phase of an exposure too little dose is measured, the exposure is aborted to protect the patient.

- Time of control measurement: 10% of backup time, min. 250ms at TDC
- Dose minimum: 4% of set density voltage at AEC, 4 ... 10% at TDC
- Backup time AEC: Calculated time from 9.5 times mAs of the respective 2-factor technique, max. 4s
- Backup time TDC: Exposure time set 0.3 ... 6s

This additional precaution can be switched OFF for both techniques individually in the menu:
PROGRAM/ DOSE RATE CONTROL/ FAULT EXPOSURE DETECTION/ **AEC OR TDC**

For details see section “FAULT FINDING”, chapter “Optimus AEC switch-OFF philosophy”.

This monitoring does not take effect in the following cases, irrespective of programming:

- Using screen/film combinations with high speed in AEC technique.
- Exposure time in TDC technique is shorter than 1s.

8.4.5. Continuous fluoroscopy

Factors for continuous fluoroscopy can be modified:
(see also section 4 FAULT FINDING, “Explanation of programming”)

- scantime TV [ms] : = 20.00ms (default) for scantime of the TV system ≤ 20ms (50Hz and 60Hz)
  = Scantime of the TV system for scantime > 20ms
- scantime TV valid : = YES default
  = NO no function yet
- P_max_EDL [W] (range = 0 ... 9000W) : = 250W (default) (EDL = Entrance Dose Limiter)
  The maximum output of the tube during continuous fluoroscopy and with the SID signal prevailing is limited to the programmed wattage.
  P_max_EDL [W] is only active if the DRLM (Dose Rate Limiter) signal on 1 WBX12:1 is active (see also Z1-15.2)
  For adjustment see section 6 ADJUSTMENTS.
- TV_pos_limit [V] (range = +3 ... +7.5V) : = 6.8V (default) Adjustment necessary if the fluoroscopic image does not come up properly.
  See section 6 ADJUSTMENTS.
- TV_neg_limit [V] (range = -7.5 ... -3V) : = -6.8V (default)

8.5. Application limits

8.5.1. X-mode limits

Using the menu:
PROGRAM/ APPLICATION LIMITS/ **X-MODE LIMITS**

Limit values can be defined for all available techniques. Some values look as if they are out of limit which they are indeed, but there are additional basic limit values programmed in the generator firmware. These are exposure technique dependent.

As an example the field of the "Falling Load" technique:

X-ray Mode:	AEC falling load kV
Min. Time Limit [ms]:	[1.00]
Max. Time Limit [ms]:	[60000.00]
Min. Current Time Product Limit [mAs]:	[0.001]
Max. Current Time Product Limit [mAs]:	[580.000]

Min. Time Limit [ms]: Is always 1ms for all non-AEC (Automatic Exposure Control) techniques. Exposures with AEC might be switched shorter than 1ms.

Max. Time Limit [ms]: Basic limits are technique dependent and can not be changed or increased:

AEC falling load	kV	4000ms
AEC fixed current	kV-mA	4000ms
TDC (Tomo Density Control)		6000ms
free techniques	kV-mA-ms	16000ms
	kV-mAs	16000ms
	kV-mAs-ms	16000ms

Min. Current Time Product Limit [mAs]: The smallest mAs - product is 0.5mAs. AEC exposures with less than 0.5mAs are possible.

Max. Current Time Product Limit [mAs]: The default mAs - product is 580mAs for all AEC-techniques. 850mAs is the absolute limit the generator terminates.

Note
Local limits have to be taken into consideration.

8.5.2. Thoravison limits

The kV-dependent mAs limits can be accessed via the menu:
PROGRAM/ APPLICATION LIMITS/ **THORAVISION LIMITS**

They are activated only in conjunction with an online Thoravision unit.
A change may only be made if instructed to do so by the service center.

Reference files on floppy disk:	- ref_limx.tdl	X-ray limits
Reference files on system disk Thoravision:	- TH_LI128.tdl - TH_LI64.tdl - TH_LI32.tdl = ref_limt.tdl	

8.5.3. Overload-dependent limits

- max. current for continuous fluro [mA]: Range = 3 ... 30mA
- max current during overload for continuous fluro [mA]: Range = 1 ... 3mA

8.6. Human interface

> **Note**
>
> *The Optimus generator of this system might has been delivered without APR option.*
> *Before spending time trying to load APR check:*
>
> XRGSCOPE
>   >> Faultfind
>   >> Power ON Results
>   >> APR disabled: [No] = APR option present
>   APR disabled: [Yes] = No APR possible
>
> *If APR shall be possible order*
>   *MGR 0011 (change of an existing configuration)*
>   *MGR 2181 APR*
> *with the generator serial number.*

A maximum of up to 1024 APRs can be stored in the generator.

On a single RGDV button either up to 80 APRs can be programmed directly (10 pages of 8 each) or up to 400 APRs via menus.

The initial data sets are called ### APR name ### and they all have the same exposure parameters.

They can be directly assigned or via menu and submenu levels to registration devices RGDV 1 ... 8.

In case TEST APR is displayed after selection of a registration device, at least this particular registration device has not been assigned to any APRs.

8.6.1. Additional program settings for generators without option APR

In case of a generator without option APR 9890 000 0282x, the menu/APR display field must be dark until selection of all exam./aux. units.
If it does not work AR_EMPTY.tdl must be loaded from the service disk for each exam./aux. unit.

In case TEST- APR appears in the menu/APR display field upon selection of the exam./aux. units, the AR_EMPTY.tdl can be loaded immediately because no APR/T is assigned to the exam./aux. unit.

In case another APR or menu appears on the desk it must be deleted before the AR_EMPTY.tdl can be loaded:

- Delete the APR/T under each exam./aux. unit.
  Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/
  MANUAL ASSIGNMENT/ **DELETE MENU**

After a RESET of the generator TEST APR appears in the menu/APR display field for each exam./aux. unit.

Now the AR_EMPTY.tdl can be loaded from the service disk for all exam./aux. units.

- Load AR_EMPTY.tdl for all exam./aux. units.
  Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/
  PREDEFINED ASSIGNMENTS

A list of possible TDL-files appears on the screen.

- Select file "AR_EMPTY.tdl" from the list.

Only "none APR" appears.

Extended APR data table

No	APR Name	Tomo no.	Foc	V [%]	kV	mA	ms	mAs	Dose [μGy]	Dens.	Fields l m r	Technique pref background	Spectral Filter	FSC	Fluo. Curve	Menu Name	Submenu Name
1	buckytable	1	1		77	600.0	53.3	32.0	2.50	0	m	RAEC RUQ	none	400	1		
2	tomography	1	1		77	16.0	2000.0	32.0	2.50	0	m	RAEC RUQt	none	400	1		
3	wallstand	1	1		77	600.0	53.3	32.0	2.50	0	m	RAEC RUQ	none	400	1		
4	free cassette	1	1		77	600.0	53.3	32.0	2.50	0	m	RAEC RUQ	none	400	1		

- Select it for each active exam./aux. unit.

After a RESET of the generator the menu/APR display field is dark for all exam./aux. units.

8.6.2. Language

- Assign the desired language.
  Select menu:
  PROGRAM/ HUMAN INTERFACE/ **SELECT LANGUAGE**

A language menu appears:

- English
- German
- French
- Spanish

- Select the desired language.
- RESET the generator.

A table lists which characters can be displayed on the control desk and how they can be indicated/entered at the service PC, e.g. for APR names, see drawing 2Z-3 “List of characters”.

Certain characters can be generated at the PC only via the decimal code. To do so, push the **<ALT>** key on the PC and enter the numerical code.

8.6.3. Automatic programming of APRs (option)

Note
Pay attention in the rules of “PC and generator settings to avoid problems during up/downloading of CU complete files” described in chapter 7.1 of this section.

The installation disk contains data files for a complete, typical APR programming in different languages. Standard APR programs for each application can easily and quickly be loaded for each registration device.

- Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/
  PREDEFINED ASSIGNMENTS

All files consist of the the same format “A***my**.tdl”

- Select with **<TAB>** and **<UP-/DOWN-ARROWS>** one of the files listed:

AR_EMPTY	=	for generators without APR option 9890 000 0282x
A*******	=	APR data file
***my**	=	Release **m**onth / **y**ear
*TS..V	=	Bucky TS with VARIOFOCUS RO 1648, RO 1750, SRO 2550 SRO 33 100
*T..V9	=	Bucky TS with VARIOFOCUS SRO 0951
*CO	=	Cosmos
*D	=	DigitalDiagnost
*R	=	Radiography
*DS	=	DSI, EasyDiagnost
*D15/76/96	=	R/F systems
*SI	=	EasyDiagnost, D15
*F	=	Fluoro stands, DSI spotfilm
*TR	=	Trauma
*TS	=	BuckyTS
*V	=	VARIOFOCUS RO 1648, RO 1750, SRO 2550, SRO 33 100
*V9	=	VARIOFOCUS SRO 0951
*M	=	Mono focus tube
*P	=	Pediatrics
***DE(U)	=	German version
***ES(P)	=	Spanish version
***EN(G)	=	English version
***FR(A)	=	French version

```
Example:   A  D  91 V  9  EN.tdl
           |  |  |  |  |  |
           |  |  |  |  |  English version
           |  |  |  |  Tube SRO 0951
           |  |  |  VARIOFOCUS
           |  |  Release: September 2001
           |  DigitalDiagnost
           APR data file
```

Some files contain data sets in a window: **Available Examination Unit Type**

- Select one of the files listed and load it:

BUCKY **GR**	=	Bucky table APR **group** layer (menu technique)
BUCKY **PA**	=	Bucky table APR **paging** (scrolling through pages technique)
WALLSTAND GR	=	Bucky wallstand group
WALLSTAND PA	=	Bucky wallstand paging
FREE GR	=	Free technique (non-AEC) group
FREE PA	=	Free technique (non-AEC) paging
TOMO LT/HDH	=	Linear tomography with units HDH, BTS2, BTS4 group
TOMO LIN/PA	=	Linear tomography with units HDH, BTS2, BTS4 paging
TOMO BTC GR	=	Tomography with unit BuckyDiagnost TC group
TOMO BTC PA	=	Tomography with unit BuckyDiagnost TC paging
TOMO BTH GR	=	Tomography with unit BuckyDiagnost TH group
TOMO BTH PA	=	Tomography with unit BuckyDiagnost TH paging

- Repeat this procedure for each registration device.
- RESET the generator.

Now all APR programs which have been loaded are displayed on the desk.

If required:

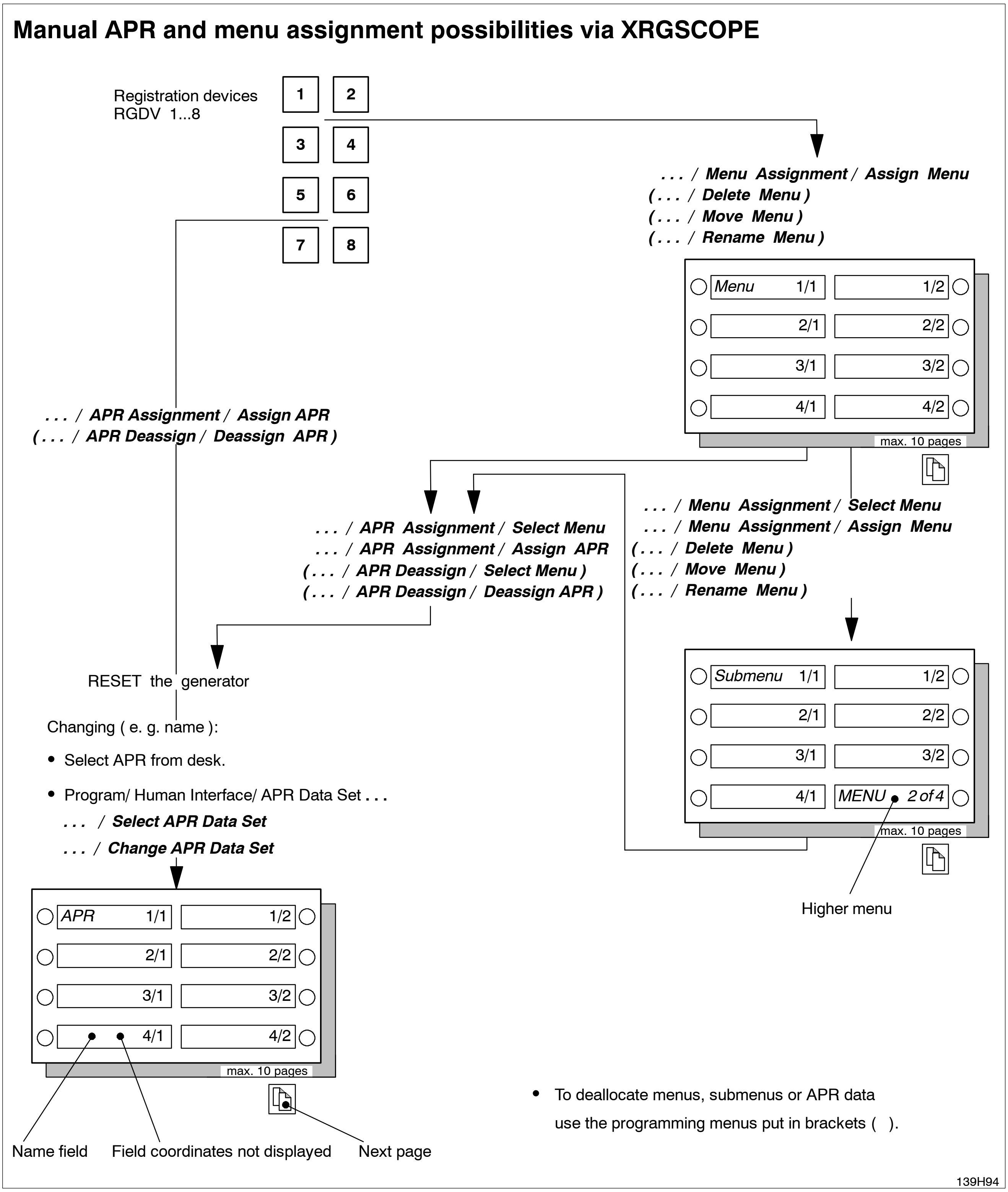
- Change the menus and the assignments of the APRs according to chapter 8.6.4.
- Change the names and the contents of the APRs according to chapter 8.6.5.

Note
In case a complete APR program setting has to be replaced by another program setting, all other APR program settings under the registration device concerned must be deleted first.
Use APRMAN.
For deleting a program setting call menu:
PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ MANUAL ASSIGNMENTS/ **DELETE MENU**

and select the blank line.

8.6.4. Manual programming of APRs (option)

- Use APRMAN.
  Select service menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/
  MANUAL ASSIGNMENT/ **. . .**



8.6.4.1. Creating menus

- Assign the desired menu.
  Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ MANUAL ASSIGNMENT/ **ASSIGN MENU**
- Enter the first menu name, e.g. <Body region 1>.
- If required, change the location suggested in the display. Otherwise the next vacant location is assigned.
- Enter the second menu name, e.g. <Body region 2>.

Etc.

8.6.4.2. Creating sub menus

- Assign the desired sub menu.
  Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ MANUAL ASSIGNMENT/ MENU ASSIGNMENT/ **SELECT MENU**
- Select with the **<CURSOR>** from one of the windows a menu to be assigned with submenus.
- Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ MANUAL ASSIGNMENT/ MENU ASSIGNMENT/ **ASSIGN MENU**
- Enter the first submenu name, e.g. <Left side>.
- If required, change the location suggested in the display. Otherwise the next vacant location is assigned.
- Enter the second submenu name, e.g. <Right side>.

Etc.

8.6.4.3. Assigning APRs

- Assign desired APRs.
  Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ MANUAL ASSIGNMENT/ APR ASSIGNMENT/ **SELECT MENU**
- Select with the **<CURSOR>** from one of the windows a menu or submenu.
  If no menu layer is desired, proceed.
- Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ MANUAL ASSIGNMENT/ APR ASSIGNMENT/ **ASSIGN APR**
- Select from one of the windows an initial APR or an APR which has not been assigned.

Initial APR:	### APR name ###
Not assigned APR:	e.g. <Thorax ap>

- If required, change the location suggested in the display. Otherwise the next vacant location is assigned.
- Assign the next APR.

Etc.

- RESET the generator.

Only after a RESET of the generator the menus, submenus and APRs are displayed on the desk.

8.6.5. Changing of APR radiation parameters

- Select the APR to be changed on the desk, e.g. ### APR name ###.

- Select menu:
  PROGRAM/ HUMAN INTERFACE/ APR DATA SET/ **SELECT APR DATA SET**

  The number of the APR selected on the desk is displayed. Transmit data by pushing **<F2>**.

- Select menu:
  PROGRAM/ HUMAN INTERFACE/ APR DATA SET/ **CHANGE APR DATA SET**

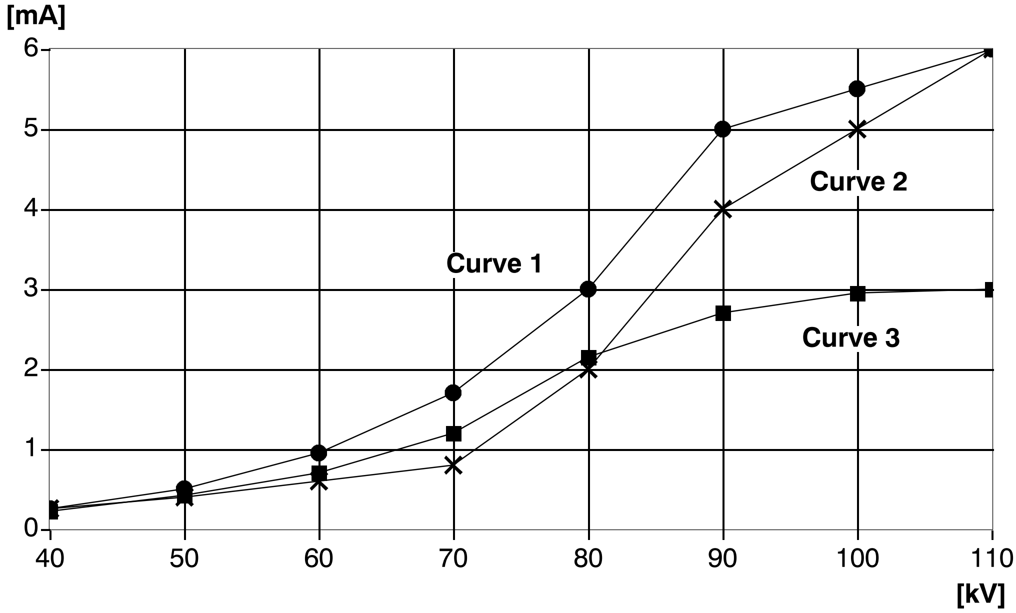
- Change the contents of the APR, e.g. <NAME>, <kV> etc.

- Select the kV value according to the dose-equivalent series:
  40-41-42-44-46-48-50-52-55-57-60-63-66-70-73-77-81-85-90-96-102-109-117-125-133-141-150 kV.

Parameter	Value	Remark
APR number	1 ... 1024	
APR name	up to 16 characters	
Focus	– Δ small – Δ vario – Δ large	
VARIOFOCUS ratio [%]	20%, 35%, 50%, 65%, 80% of small focus	
Dose measurement field (left)	Δ ON/OFF	AEC operable only if at least one field is ON
Dose measurement field (middle)	Δ ON/OFF	
Dose measurement field (right)	Δ ON/OFF	
Preferred technique	–non automatic –automatic	
AEC technique	– AEC falling load kV – AEC fixed current kV-mA – TDC	
No AEC technique	– kV-mA-ms – kV-mAs – kV-mAs-ms	
Tube current max. factor [%]	1 ... 100	
PSC U thin (dose equiv. steps)	0 ... 5	
PSC U thick (dose equiv. steps)	0 ... 5	
PSC Q thin (6% steps)	0 ... 10	
PSC Q thick (6% steps)	0 ... 10	
PSC dens. thin (6% steps)	0 ... 10 (max. limit = 8)	
PSC dens. thick (6% steps)	0 ... 10 (max. limit = 8)	
Exposure data U [kV]	Δ 40 ... 150	
Exposure data I [mA]	Δ 0.1 ... 2000	
Exposure data Q [mAs]	Δ 0,5 ... 850	
Exposure time [ms]	Δ 1 ... 16000 (60000)	
Exposure data density (6% steps)	Δ –40 ... +40 (max. limit = ±8)	
Screen/film combination	Δ RGDV dependent	Default = Data Set 1
Tomo no.	1 ... 16 assignment of a tomographic figure	
Spectral filter	– none – 2mm Al – 0.1mm Cu + 1mm Al – 0.2mm Cu + 1mm Al	Default = none
Fluoroscopy curve (for details see figure on next page)	1–20 Select kV/mA = curve 1, 2, 3 Curve 1: 70kV ––> 1.7mA 110kV 6mA Curve 2: 70kV ––> 0.8mA 110kV 6mA Curve 3: 70kV ––> 1.2mA 110kV 3mA	Default = curve 1 Curves loaded from the disk.

Δ = The basic setting of these data can also be performed from the desk (RESET + APR). Refer to the operator's manual.

kV	Curve 1 mA	Curve 2 mA	Curve 3 mA
40	0.25	0.25	0.22
50	0.5	0.4	0.42
60	0.95	0.6	0.70
70	1.7	0.8	1.20
80	3	2	2.15
90	5	4	2.70
100	5.5	5	2.95
110	6	6	3.00



kV/mA – curves: Fluoroscopy Optimus R/F

414H01

The following parameters must also be taken into account for AEC techniques:

- mAs: basis for calculating the backup time for AEC, the tube current for AEC fixed current (kV-mA) and the initial mA value for TDC
- t: exposure time for TDC and AEC fixed current

For details see chapters 8.6.5.2 and 8.7.

If AEC FIXED CURRENT kV-mA or TDC is programmed as the preferred technique, the kV/mA/s or kV/mAs/s technique must be selected under NO AEC TECHNIQUE.

- Transmit data by pushing **<F2>**.
- Select the next APR on the desk, select it in the programming menu and change it.

Etc.

- RESET the generator.

Organ-dependent correction:

- Select the APR to be changed on the desk.
- Select menu:
  PROGRAM/ HUMAN INTERFACE/ APR DATA SET/ **CHANGE APR DATA SET**

  Transmit the displayed APR number by pushing the **<F2>** key.
- Select menu:
  PROGRAM/ HUMAN INTERFACE/ APR DATA SET/ **CHANGE APR DATA SET**
- Exposure data density: -40 ... +40 = correction in steps of 6%. Max. limit = ±8.

  The number of correction steps must match the programmed step rate.

  Example:
  The desk display has been programmed to 12% step rate in the menu:
  PROGRAM/ REGISTRATION DEVICE/ RGDV 1 ... 8/ DATA SET B/ **DENSITY STEPS**

  To be able to display a density correction of +1 for a certain APR, two corrections steps (2 x 6% = 12%) must be programmed under this APR.
- Select the next APR on the desk, select it in the programming menu and change it.

Etc.

- RESET the generator.

Correction for each RGDV 1 ... 8:

This correction is possible but for reasons of clarity it should not be used.

- Select menu:
  PROGRAM/ REGISTRATION DEVICE/ RGDV 1 ... 8/ **DATA SET B**
- Density correction: -8 ... +8 = correction in steps of 6%.

8.6.5.1. Density correction for non-AEC techniques

The supplied APR standard sets are mostly based on a screen/film combination with a speed class of 400. APRs for extremities and some other applications are based on a 100 or 200-type system. Depending on the local situation the mAs or s parameters of all the relevant APRs must be adapted.

Example:
The customer uses a 200-type system. To change from the existing 400 values the relevant APRs must be reprogrammed to double the mAs products or to double the exposure time (400 divided by 200 = 2).

- Select the relevant APR at the control desk.
- Set the new parameters at the control desk.
- Save the new parameters as default values.
  To do this push the RESET button and the corresponding APR button. The asterisk in the APR name as an indication of overwritten data disappears.
  Use APRMAN.

8.6.5.2. AEC fixed current (kV-mA)

For this exposure technique the APRs must have the following programmings:

- Dose measurement field: ON (at least 1 field must be set to ON)
- Preferred technique: automatic
- AEC technique: AEC fixed current kV-mA
- No AEC technique: kV-mAs-ms technique (RUQT) or kV-mA-ms (RUIT)
- Exposure data U: = anatomical kV value
- Exposure data Q/I: = anatomical mAs/mA product based on the screen / film combination used
- Exposure time t: = anatomical exposure time
  The mA value is calculated automatically.

In the APR standard files supplied the following APR's is programmed to kV-mA technique:

Dens axis F	/ dens axis F	/ dens axis F	/ atlas F
(German	/ English	/ French	/ Spanish)

The APR is marked with F.

The mAs value is based on a 400-type screen/film combination and must be adapted to the combinations actually used.
E. g.: If a 200-type combination is used, the mAs value must be doubled.

If the TDC option is installed, the preferable technique for all exposures is the one where the exposure time is the determining factor. TDC is not restricted to tomography applications only.

8.6.6. Moving / copying of an APR data set

Determination of the number of APR data set X to where APR data set Y is to be moved / copied.

- Select APR data set **X** on the desk.
- Select menu:
  PROGRAM/ HUMAN INTERFACE/ APR DATA SET/ **SELECT APR DATA SET**
- Note down the number of APR data set **X**, e.g. 100.

Changing of the number of APR data set Y to be moved / copied to the number of APR data set X

- Select APR data set **Y** on the desk.
- Select menu:
  PROGRAM/ HUMAN INTERFACE/ APR DATA SET/ **SELECT APR DATA SET**

  Transmit by pushing **<F2>**.
- Select menu:
  PROGRAM/ HUMAN INTERFACE/ APR DATA SET/ **CHANGE APR DATA SET**
- Replace the number of APR data set **Y** with the number of APR data set **X** in the input mask, e.g. nnn ⇒ 100.
- Transmit this number by pushing **<F2>**.
- RESET the generator.

APR data set **Y** is displayed in place of the old APR data set **X** on the desk.
In case APR data set **Y** is merely moved and not copied to the location of APR data set **X**, the original APR data set **Y** must be deleted at the end of programming.

8.6.7. Deleting of APRs

- Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ MANUAL ASSIGNMENT/ APR DEASSIGN/ **SELECT MENU**

  Required only if the APR is assigned to a menu or submenu.

- Select the associated menu or submenu from one of the windows.
- Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ MANUAL ASSIGNMENT/ APR DEASSIGN/ **DEASSIGN APR**
- Select the APR to be deleted from one of the windows.
- RESET the generator.

An APR which has been deleted is no longer displayed on the desk but remains stored in the generator.
It can be re-activated according to chapter 8.6.4.

8.6.8. Manipulating menus

Deleting:

- Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ MANUAL ASSIGNMENT/ **DELETE MENU**
- Select the menu or submenu to be deleted from one of the windows.
  For deleting all APRs of an RGDV program select the blank line.
- RESET the generator.

Shifting:

- Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ MANUAL ASSIGNMENT/ **MOVE MENU**
- Select the menu or submenu from one of the windows.
- Enter the new positions.
- RESET the generator.

Renaming:

- Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ MANUAL ASSIGNMENT/ **RENAME MENU**
- Select the menu or submenu from one of the windows.
- Enter the name in the lowermost line.
- RESET the generator.

8.6.9. External APR assignment

A maximum of 2 external APRT modules can be connected to the Optimus R/F via adapter 4 auxil. units 1WA, 2WA and WB.
Refer Z1-15.1 ”Adapter 4 auxil. units”.

- Define the external APRT modules by placing links W1 through W3 on adapters WA/WB.
  Also see table ”Assignment of the external APRT modules” below and Z1-15.1 ”Adapter 4 auxil. units”.

- Program the desired APRT in the generator.

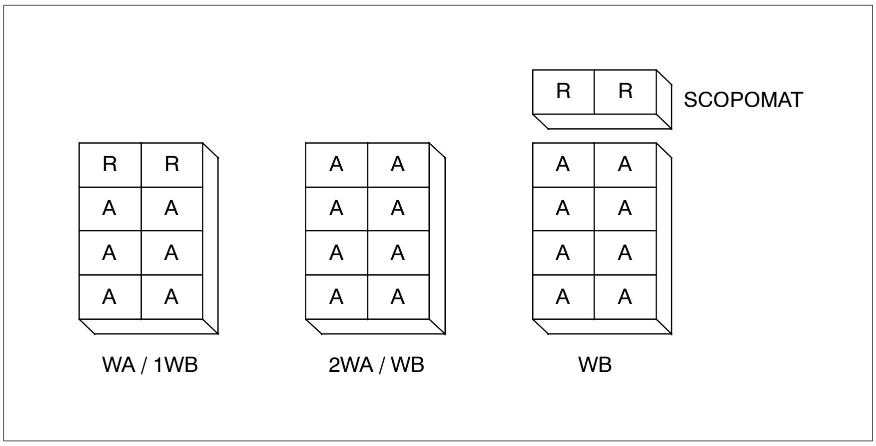
- Select the desired APRT numbers for the external APRT modules from the RGDVs:
  PROGRAM/ HUMAN INTERFACE/ APR DATA SET/ **SELECT APR DATA SET**

- Program the RGDVs that are to be switched over by the external APRT modules.
  Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ EXTERNAL APR ASSIGNMENT/ **...**
  .... DEVICE INTERFACE 1
  or
  .... DEVICE INTERFACE 3

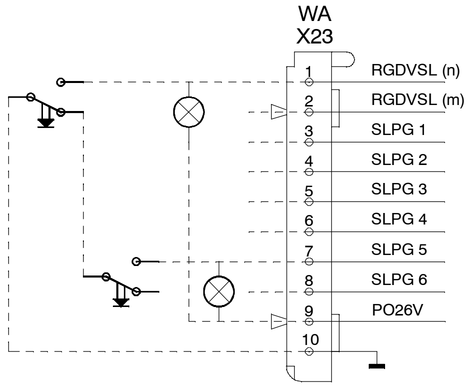
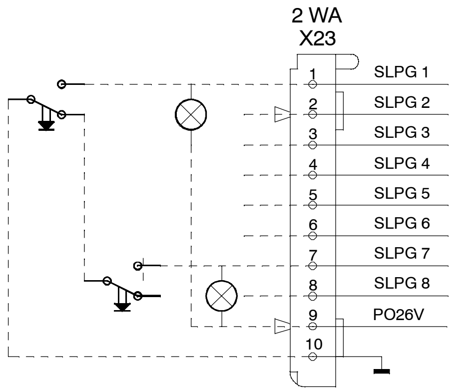
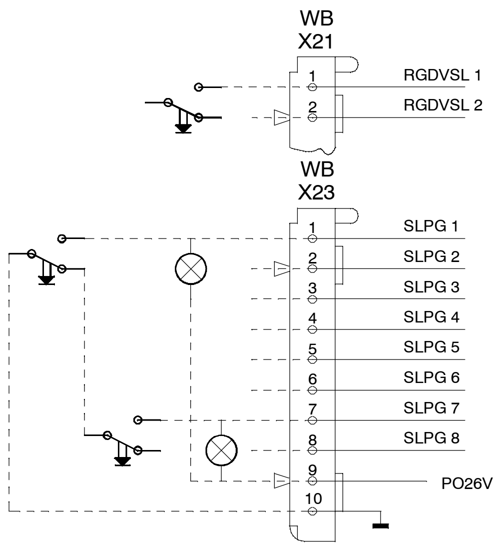
Only two RGDVs can be programmed and, respectively, switched over. Once programmed these two RGDVs are valid irrespective of the selected APRs of the other buttons of the module.

- Program the APRs that are to be selected by the external APR/T modules.
  Select menu:
  PROGRAM/ HUMAN INTERFACE/ RGDV RELATED ASSIGNMENT/ RGDV 1 ... 8/ EXTERNAL APR ASSIGNMENT/**...**
  .... DEVICE INTERFACE 1 : 6 APR keys can be assigned for each RGDV
  and/or
  .... DEVICE INTERFACE 2 : 8 APR keys can be assigned for each RGDVand/or
  and/or
  .... DEVICE INTERFACE 3 : 8 APR keys can be assigned for each RGDV

- Enter the RGDVs and APRs programmed for the 3 device interfaces in table 2Z-5 ”Programming of device interfaces”.



Assignment of the external APRT modules:

Device interface	Adapter	Programming W1/W2/W3	Hardware connection	Remark
1	WA or 1 WA	W1-W3 open		2 selectable RGDVs can be programmed. They are independent of the APRs programmed. Maximum number of APRs: 6 x 8 (RGDV) = 48 APRs Recommendation: 2 APRs assigned to each button.
2	2 WA	only W1 closed		RGDV cannot be selected. Maximum number of APRs: 8 x 8 (RGDV) = 64 APRs Recommendation: 2 APRs assigned to each button. Operation as 2 WA is possible also without 1 WA. Refer to drawing Z2-15.1 Cabinet wiring: Decade adapter WA
3	WB	only W2 closed		2 selectable RGDVs can be programmed. They are independent of the APRs programmed. Maximum number of APRs: 8 x 8 (RGDV) = 64 APRs Recommendation: 2 APRs assigned to each button

8.7. Option: Tomo Density Control TDC

For this exposure technique the APRs must have the following programming:

- Dose measurement field:	ON (at least 1 field must be set to ON)
- Preferred technique:	automatic
- AEC technique:	TDC
- No AEC technique:	kV-mAs-ms technique (RUQT) or kV-mA-ms (RUIT)
- Exposure data U:	= anatomical kV
- Exposure data Q/I:	= anatomical mAs/mA product based on the screen/film combination used
- Exposure time t:	= anatomical exposure time

The mAs product is used to calculate the start current, indicated under “Exposure data I”.
In the APR files supplied all the APRs for tomography applications are programmed to TDC. If there is no TDC option installed, the manual technique is selected as the preferred technique automatically.

TDC is not restricted to tomography applications only so it can be preferred for all exposures where exposure time is the determining factor.

The respective mAs product is generally based on a 400-type screen/film combination and must be adapted to the combinations actually used.
E. g.: If a 200-type combination is used, the mAs product must be doubled.

8.8. Option: VARIOFOCUS

For the VARIOFOCUS option, special APR files have to be loaded. These are designated with a ”V” in the file name and contain correspondingly defined APRs.

VARIOFOCUS is programmed as a percentage mix of the small focus with the large focus.
The following steps are possible:
20%, 35%, 50%, 65% and 80% of the small focus.
Default: 50%.

The percentage mix is not displayed directly on the control desk and can only be estimated indirectly via the small/large focus exposure time.

It is only possible to display and change the percentage mix via XRGSCOPE.

- Select menu:
  PROGRAM/ HUMAN INTERFACE/ APR DATA SET/ **CHANGE APR DATA SET**

  However, VARIOFOCUS can be selected via the control desk and can be stored as default focus for an APR, too.
  The default ratio is always 50%.

VARIOFOCUS is possible for tubes with superimposed focal spots only.

The following tubes are suitable for the application: RO 1648, RO 1750, SRO 0951, SRO 2550, SRO 33 100.

8.9. Option: Area Dose Calculator

This option operates in conjunction with a unit and a collimator which are CAN-controlled and supply information about SID, collimation and added filters only.

See section 6: ADJUSTMENTS
  chapter 1.x: Checking / Correction

8.10. Acceptance test

- Execute the acceptance test.
  See section 7: ACCEPTANCE

- Observe all applicable national regulations.

For U.S.A applications check the H.H.S requirements!

After completition of setting-to-work, the system must be tested for H.H.S. compliance according the P.M.S.I. comprehensive compliance testing workbook: Numeric code 4535 800 2035x.

8.11. Interlock facility for APR modification

- Select menu:
  PROGRAM/ HUMAN INTERFACE/ **APR MODIFIABLE BY USER**

  It is possible to prevent a customer from being able to store APR modifications as default setting via the control desk.

  Default: YES

8.12. Backup of all configuration data

A hardware key is required for the PC.

To save the configuration data use the CONFIGURATION BACKUP disk supplied.

- Save the complete SW programming of the generator on the floppy disk by using the menu:
  ACCEPT/ BACKUP/ ...

1. ... RGDV RELATED ASSIGNMENTS/ RGDV 1 ... 8/ **APR ASSIGNMENTS**

   Use APRMAN.

   After READING (turning bar) the PC offers the default backup name:
   Backup filename: **APR_BAK1 ... 8.tdl**
   The name can be changed into any other file name.
   The path (harddisk) is automatically taken into account.
   It is also possible to type:
   A:\”filename” <RETURN>
   to load the backup files directly to the floppy disk.

2. ... **CU complete**

   Note
   Pay attention to the rules of “PC and generator settings to avoid problems during up/downloading of CU complete files” described in chapter 7.1 of this section.

   A disk space of 700kByte is required.
   It takes about 8min to save the data to the disk.

   The default backup name:
   Backup File Name: **CUBACKUP.TDL**
   The name can be changed into any other filename.
   The path (harddisk) is automatically taken into account.
   It is also possible to type:
   A:\”filename” <RETURN>
   to load the backup files directly to the floppy disk.

9. Labels

- Check the labelling according to the respective generator type.

See drawing 2Z–10 “Labelling”.

All lables become visible by swiveling out the label bracket simply by hand and without any tool. The bracket is located at the top left corner of the front side of the cabinet, visibly marked by an ”i” (for information) and text ”Certified Component Labels Here”. If the label bracket is swiveled 90 degrees to the right the following labels appear at its bottom side:

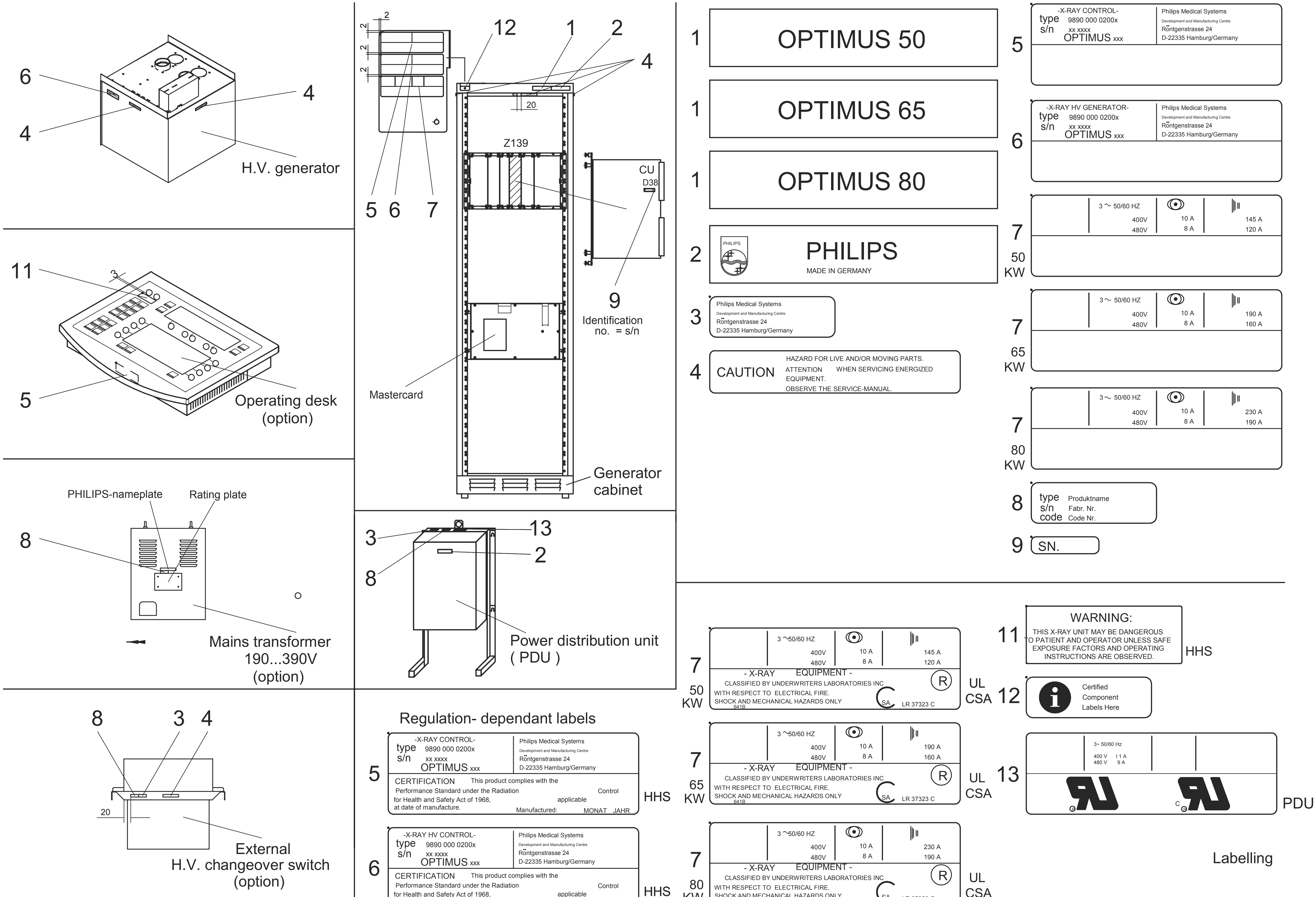
- X-ray control:
  - type designation
  - serial No.
  - name and address of manufacturer
  - DHHS certification statement (if necessary)
  - date of manufacture
- X-ray H.V. generator:
  - type designation
  - serial No.
  - name and address of manufacturer
  - DHHS certification statement (if necessary)
  - date of manufacture
- Technical data label with UL / CSA classification (if necessary)

10. Final installation work

- Mount the side panels of the generator cabinet.
- Take care that all cables inside the wall junction box are routed in **closed** loops without any kinks.
  Push the generator cabinet against the wall.

Warning!
Block the two front wheels of the cabinet with the locking screws to guarantee that unauthorized persons cannot accidentally touch parts of the generator which might be dangerous.

- If necessary, level the cabinet with the locking screws.
- Mount the front cover of the generator.



Labelling

A3/A3 97-11-26 Schr.

- - **Name :**								
Data Set A : Desk :	RGDV1	RGDV2	RGDV3	RGDV4	RGDV5	RGDV6	RGDV7	RGDV8
- Room :								
- Tube :								
- Release circuit number :								
- Enable handswitch at generator desk :								
- Syncmaster present :								
- Exposure switch type :								
- Bucky format density correction :								
- Cone density correction :								
- Dose measurement input :								
- Dose measurement sensor :								
- Exposure series/Tomo movement (No break after exposure end):								
- Release delay :								
- Mounted radiographical controller :								
- Release circuit adaptation unit :								
- Mounted tomo extension :								
- Medium II format kV correction (dose equiv. steps) :								
- Medium II format density correction (6% steps) :								
- Medium II format mAs correction (6% steps) :								
- Small II format kV correction (dose equiv. steps) :								
- Small II format density correction (6% steps) :								
- Small II format mAs correction (6% steps) :								
Data Set B :								
- Used for tomo :								
- Used for fluoroscopy :								
- CT add on :								
- Disable time override :								
- Tube power factor :								
- kV steps :								
- mAs steps :								
- mA steps :								
- time steps :								
- Density steps :								
- Density correction (6% steps) :								
- Underexposure display :								
- Tube overload protection :								

Bucky / Scopo 1WB / Decade Bucky 1 (WBX11) :		**Bucky / Tomo 1WA : Decade Bucky 1/2**	**WAX11**	**WAX12**	**Bucky / Tomo 1WA \ Tomo time [s] :**			
Bucky RGDV :	RGDV1 [ ] RGDV2 [ ] RGDV3 [ ] RGDV4 [ ] RGDV5 [ ] RGDV6 [ ] RGDV7 [ ] RGDV8 [ ]	Tomo mode switch			Tomo time 1 :		Tomo time 5 :	
		Bucky RGDV - switch related			Tomo time 2 :		Tomo time 6 :	
		Bucky RGDV			Tomo time 3 :		Tomo time 7 :	
		Bucky RGDV			Tomo time 4 :		Tomo time 8 :	
		Tomo RGDV - switch related			Time setting for input at WA X21:1 8			
For WBX11 : 9 --10 (ready) und 1--2 (format size correction contact)		*Tomo mode switch : X11:3 SL_XG_TO / Bucky RGDV : X11:1 Format + :10 Bucky ready / Tomo RGDV : X11:1 Format + :5 Tomo ready switch related X11:3 --> Bucky - Tomo remote switchover RGDVs*						

*- **D76 : Exposure Scopo / BV-DSI*** *- Bucky wall stand / - Free cassette* ***Name :***	D 76 Scopo	D 76 BV - DSI	Bucky wall stand	Free cassette	Free cassette USA			
Data Set A : Desk :	RGDV1	RGDV2	RGDV3	RGDV4	RGDV4	RGDV6	RGDV7	RGDV8
- Room :	1	1	1	1	1			
- Tube :	1	1	2	1	1			
- Release circuit number :	1	2	3	(4)	4			
- Enable handswitch at generator desk :	no	no	yes	yes	yes			
- Syncmaster present :	yes	yes	yes	no	yes			
- Exposure switch type :	double step	double step	double step	double step	double step			
- Bucky format density correction :	0	0	0	0	0			
- Cone density correction :	0	0	0	0	0			
- Dose measurement input :	EZ X21	EZ X41	EZ X31	none	none			
- Dose measurement sensor :	Scopo amplimat	photo sensor/ amplimat input	Bucky amplimat	(Bucky amplimat)	(Bucky amplimat)			
- Exposure series :	yes	yes	no	no	no			
- Release delay :	enable	enable	enable	enable	enable			
- Mounted radiographical controller :	none	none	none	none	none			
- Release circuit adaptation unit :	1WB	1WB	1WB	none	1WB			
- Mounted tomo extension :	none	none	none	none	none			
- Medium II format kV correction (dose equiv. steps) :	0	0 [1)]	0	0	0			
- Medium II format density correction (6% steps) :	0	0 [1)]	0	0	0			
- Medium II format mAs correction (6% steps) :	0	0 [1)]	0	0	0			
- Small II format kV correction (dose equiv. steps) :	0	0 [1)]	0	0	0			
- Small II format density correction (6% steps) :	0	0 [1)]	0	0	0			
- Small II format mAs correction (6% steps) :	0	0 [1)]	0	0	0			
Data Set B :								
- Used for tomo :	no	no	no	no	no			
- Used for fluoroscopy :	yes	yes	no	no	no			
- CT add on :	no	no	no	no	no			
- Disable time override :	no	no	no	no	no			
- Tube power factor :	100 %	100 %	100 %	100 %	100 %			
- kV steps :	Dose equiv. [1)]	Dose equiv. [1)]	Dose equiv. [1)]	Dose equiv. [1)]	Dose equiv. [1)]			
- mAs steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]			
- mA steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]			
- time steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]			
- Density steps :	12 % [1)]	12 % [1)]	12 % [1)]	12 % [1)]	12 %			
- Density correction (6% steps) :	0	0	0	0	0			
- Underexposure display :	yes	yes	yes	yes	yes			
- Tube overload protection :	on	on	on	on	on			

Bucky / Scopo 1WB / Decade Bucky 1 (WBX11) :		~~**Bucky / Tomo 1WA : Decade Bucky 1/2**~~	**WAX11**	**WAX12**	~~**Bucky / Tomo 1WA \ Tomo time [s] :**~~			
Bucky RGDV :	RGDV1 [x] RGDV2 [x] RGDV3 [x] RGDV4 [x] RGDV5 [ ] RGDV6 [ ] RGDV7 [ ] RGDV8 [ ]	Tomo mode switch	----	----	Tomo time 1 :	----	Tomo time 5:	----
		Bucky RGDV - switch related	----	----	Tomo time 2 :	----	Tomo time 6 :	----
		Bucky RGDV	----	----	Tomo time 3 :	----	Tomo time 7 :	----
		Bucky RGDV	----	----	Tomo time 4 :	----	Tomo time 8 :	----
		Tomo RGDV - switch related	----	----	Time setting for input at WA X21:1 8			
For WBX11 : 9 --10 (ready) und 1--2 (format size correction contact)		*Tomo mode switch : X11:3 SL_XG_TO / Bucky RGDV : X11:1 Format + :10 Bucky ready / Tomo RGDV : X11:1 Format + :5 Tomo ready switch related X11:3 --> Bucky - Tomo remote switchover RGDVs*						

1) = has to be adjustet on site

RGDV programming: example 1

- Bucky Diagnost TH with Bucky-Controller - D76 : Exposure Scopo / BV-DSI ***Name :***	Bucky	Tomo	Bucky wall stand	Free cassette	D 76 Scopo	D 76 BV - DSI		
Data Set A : Desk :	RGDV1	RGDV2	RGDV3	RGDV4	RGDV5	RGDV6	RGDV7	RGDV8
- Room :	1	1	1	1	1	1		
- Tube :	1	1	1	1	2	2		
- Release circuit number :	do not care	do not care	do not care	do not care	1	2		
- Enable handswitch at generator desk :	yes	yes	yes	yes	no	no		
- Syncmaster present :	yes	yes	yes	yes	yes	yes		
- Exposure switch type :	double step	double step	double step	double step	double step	double step		
- Bucky format density correction :	0	0	0	0	0	0		
- Cone density correction :	0	0	0	0	0	0		
- Dose measurement input :	EZ X21	none / [EZ X21]	EZ X31	none	EZ X22	EZ X41		
- Dose measurement sensor :	Bucky amplimat	Bucky amplimat	Bucky amplimat	(Bucky amplimat)	Scopo amplimat	photo sensor / amplimat input		
- Exposure series/Tomo movement :	no	no	no	no	yes	yes		
- Release delay :	enable	enable	enable	enable	enable	enable		
- Mounted radiographical controller :	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	none	none		
- Release circuit adaptation unit :	none	none	none	none	1WB	1WB		
- Mounted tomo extension :	none	none	none	none	none	none		
- Medium II format kV correction (dose equiv. steps) :	0	0	0	0	0	0 [1]		
- Medium II format density correction (6% steps) :	0	0	0	0	0	0 [1]		
- Medium II format mAs correction (6% steps) :	0	0	0	0	0	0 [1]		
- Small II format kV correction (dose equiv. steps) :	0	0	0	0	0	0 [1]		
- Small II format density correction (6% steps) :	0	0	0	0	0	0 [1]		
- Small II format mAs correction (6% steps) :	0	0	0	0	0	0 [1]		
Data Set B :								
- Used for tomo :	no	yes	no	no	no	no		
- Used for fluoroscopy :	no	no	no	no	yes	yes		
- CT add on :	no	no	no	no	no	no		
- Disable time override :	no	no	no	no	no	no		
- Tube power factor :	100 %	100 %	100 %	100 %	100 %	100 %		
- kV steps :	Dose equiv. [1]	Dose equiv. [1]	Dose equiv. [1]	Dose equiv. [1]	Dose equiv. [1]	Dose equiv. [1]		
- mAs steps :	25 % [1]	25 % [1]	25 % [1]	25 % [1]	25 % [1]	25 % [1]		
- mA steps :	25 % [1]	25 % [1]	25 % [1]	25 % [1]	25 % [1]	25 % [1]		
- time steps :	25 % [1]	25 % [1]	25 % [1]	25 % [1]	25 % [1]	25 % [1]		
- Density steps :	12 % [1]	12 % [1]	12 % [1]	12 %	12 % [1]	12 %		
- Density correction (6% steps) :	0	0	0	0	0	0		
- Underexposure display :	yes	yes	yes	yes	yes	yes		
- Tube overload protection :	on	on	on	on	on	on		

Bucky / Scopo 1WB / Decade Bucky 1 (WBX11) :		~~**Bucky / Tomo 1WA : Decade Bucky 1/2**~~	~~**WAX11**~~	~~**WAX12**~~	~~**Bucky / Tomo 1WA \ Tomo time [s] :**~~			
Bucky RGDV :	RGDV1 [ ] RGDV2 [ ] RGDV3 [ ] RGDV4 [ ] RGDV5 [**x**] RGDV6 [**x**] RGDV7 [ ] RGDV8 [ ]	Tomo mode switch	----	----	Tomo time 1 :	----	Tomo time 5:	----
		Bucky RGDV - switch related	----	----	Tomo time 2 :	----	Tomo time 6 :	----
		Bucky RGDV	----	----	Tomo time 3 :	----	Tomo time 7 :	----
		Bucky RGDV	----	----	Tomo time 4 :	----	Tomo time 8 :	----
		Tomo RGDV - switch related	----	----	Time setting for input at WA X21:1 8			
For WBX11 : 9 --10 (ready) und 1--2 (format size correction contact)		*Tomo mode switch : X11:3 SL_XG_TO / Bucky RGDV : X11:1 Format + :10 Bucky ready / Tomo RGDV : X11:1 Format + :5 Tomo ready switch related X11:3 --> Bucky - Tomo remote switchover RGDVs*						

1) = has to be adjustet on site
[ ] = TDC

RGDV programming: example 2

- D96 : Cassette+DSI with/without Tomo - Bucky wall stand / - Free cassette ***Name :***	D96 cassette	D96 Tomo cassette	DSI	DSI Tomo	Free cassette	Wall stand		
Data Set A : Desk :	RGDV1	RGDV2	RGDV3	RGDV4	RGDV5	RGDV6	RGDV7	RGDV8
- Room :	1	1	1	1	1	1		
- Tube :	1	1	1	1	2	2		
- Release circuit number :	1	2	3	4	1	2		
- Enable handswitch at generator desk :	no	no	no	no	yes	yes		
- Syncmaster present :	yes	yes	yes	yes	yes	yes		
- Exposure switch type :	double step	double step	double step	double step	double step	double step		
- Bucky format density correction :	0	0	0	0	0	0		
- Cone density correction :	0	0	0	0	0	0		
- Dose measurement input :	EZX 21	none / [EZX 21]	EZX 41	none / [EZX 41]	none	EZX 31		
- Dose measurement sensor :	Bucky amplimat	Bucky amplimat	photo sensor/ amplimat input	(photo sensor/ amplimat input)	(Bucky amplimat)	Bucky amplimat		
- Exposure series/Tomo movement :	yes	yes	yes	yes	no	no		
- Release delay :	enable	enable	enable	enable	enable	enable		
- Mounted radiographical controller :	none	none	none	none	none	none		
- Release circuit adaptation unit :	1WB	1WB	1WB	1WB	1WA	1WA		
- Mounted tomo extension :	1WA	1WA	1WA	1WA	none	none		
- Medium II format kV correction (dose equiv. steps) :	0	0	0 [1)]	0 [1)]	0	0		
- Medium II format density correction (6% steps) :	0	0	0 [1)]	0 [1)]	0	0		
- Medium II format mAs correction (6% steps) :	0	0	0 [1)]	0 [1)]	0	0		
- Small II format kV correction (dose equiv. steps) :	0	0	0 [1)]	0 [1)]	0	0		
- Small II format density correction (6% steps) :	0	0	0 [1)]	0 [1)]	0	0		
- Small II format mAs correction (6% steps) :	0	0	0 [1)]	0 [1)]	0	0		
Data Set B :								
- Used for tomo :	no	yes	no	yes	no	no		
- Used for fluoroscopy :	yes	yes	yes	yes	no	no		
- CT add on :	no	no	no	no	no	no		
- Disable time override :	no	no	no	no	no	no		
- Tube power factor :	100 %	100 %	100 %	100 %	100 %	100 %		
- kV steps :	Dose equiv. [1)]	Dose equiv. [1)]	Dose equiv. [1)]	Dose equiv. [1)]	Dose equiv. [1)]	Dose equiv. [1)]		
- mAs steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]		
- mA steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]		
- time steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]		
- Density steps :	12 % [1)]	12 % [1)]	12 %	12 %	12 %	12 % [1)]		
- Density correction (6% steps) :	0	0	0	0	0	0		
- Underexposure display :	yes	no	yes	no	yes	yes		
- Tube overload protection :	on	on	on	on	on	on		

Bucky / Scopo 1WB / Decade Bucky 1 (WBX11) :		**Bucky / Tomo 1WA : Decade Bucky 1/2**	**WAX11**	**WAX12**	**Bucky / Tomo 1WA \ Tomo time [s] :**			
Bucky RGDV :	RGDV1 [x] RGDV2 [x] RGDV3 [x] RGDV4 [x] RGDV5 [ ] RGDV6 [ ] RGDV7 [ ] RGDV8 [ ]	Tomo mode switch	enable	enable	Tomo time 1 :	0,6	Tomo time 5 :	3,0
		Bucky RGDV - switch related	RGDV 1	RGDV 3	Tomo time 2 :	0,3	Tomo time 6 :	1,5
		Bucky RGDV	none	none	Tomo time 3 :	1,5	Tomo time 7 :	1,0
		Bucky RGDV	none	none	Tomo time 4 :	0,7	Tomo time 8 :	1,0
		Tomo RGDV - switch related	RGDV 2	RGDV 4	Time setting for input at WA X21:1 8			
For WBX11 : 9 --10 (ready) und 1--2 (format size correction contact)		*Tomo mode switch : X11:3 SL_XG_TO / Bucky RGDV : X11:1 Format + :10 Bucky ready / Tomo RGDV : X11:1 Format + :5 Tomo ready switch related X11:3 --> Bucky - Tomo remote switchover RGDVs*						

1) = has to be adjustet on site
[ ] = TDC

RGDV programming: example 3

HDH :** without / [with tomo time input]* — ***Name :	Bucky	Tomo	Bucky wall stand	Free cassette	Free cassette USA			
Data Set A : Desk :	RGDV1	RGDV2	RGDV3	RGDV4	RGDV4	RGDV6	RGDV7	RGDV8
- Room :	1	1	1	1	1			
- Tube :	1	1	1	1	1			
- Release circuit number :	1	1	3	(4)	4			
- Enable handswitch at generator desk :	yes	yes	yes	yes	yes			
- Syncmaster present :	yes	yes	yes	no	yes			
- Exposure switch type :	double step	double step	double step	double step	double step			
- Bucky format density correction :	0	0	0	0	0			
- Cone density correction :	0	0	0	0	0			
- Dose measurement input :	EZ X21	none / [EZ X21]	EZ X31	none	none			
- Dose measurement sensor :	Bucky amplimat	Bucky amplimat	Bucky amplimat	(Bucky amplimat)	(Bucky amplimat)			
- Exposure series / Tomo movement :	no	yes	no	no	no			
- Release delay :	enable	enable	enable	enable	enable			
- Mounted radiographical controller :	none	none	none	none	none			
- Release circuit adaptation unit :	1WA	1WA	1WA	none	1WA			
- Mounted tomo extension :	none	none (1WA)	none	none	none			
- Medium II format kV correction (dose equiv. steps) :	0	0	0	0	0			
- Medium II format density correction (6% steps) :	0	0	0	0	0			
- Medium II format mAs correction (6% steps) :	0	0	0	0	0			
- Small II format kV correction (dose equiv. steps) :	0	0	0	0	0			
- Small II format density correction (6% steps) :	0	0	0	0	0			
- Small II format mAs correction (6% steps) :	0	0	0	0	0			
Data Set B :								
- Used for tomo :	no	no (yes)	no	no	no			
- Used for fluoroscopy :	no	no	no	no	no			
- CT add on :	no	no	no	no	no			
- Disable time override :	no	no	no	no	no			
- Tube power factor :	100 %	100 %	100 %	100 %	100 %			
- kV steps :	Dose equiv. 1)	Dose equiv. 1)	Dose equiv. 1)	Dose equiv. 1)	Dose equiv. 1)			
- mAs steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)	25 % 1)			
- mA steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)	25 % 1)			
- time steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)	25 % 1)			
- Density steps :	12 % 1)	12 % 1)	12 % 1)	12 %	12 %			
- Density correction (6% steps) :	0	0	0	0	0			
- Underexposure display :	yes	no	yes	yes	yes			
- Tube overload protection :	on	on	on	on	on			

~~Bucky / Scopo 1WB / Decade Bucky 1 (WBX11) :~~		**Bucky / Tomo 1WA : Decade Bucky 1/2**	**WAX11**	**WAX12**	**Bucky / Tomo 1WA \ Tomo time [s] :**			
Bucky RGDV :	RGDV1 [ ] RGDV2 [ ] RGDV3 [ ] RGDV4 [ ] RGDV5 [ ] RGDV6 [ ] RGDV7 [ ] RGDV8 [ ]	Tomo mode switch	dis(en)able	disable	Tomo time 1 :	0,8	Tomo time 5 :	0,1
		Bucky RGDV - switch related	RGDV 1	none	Tomo time 2 :	3,2	Tomo time 6 :	0,1
		Bucky RGDV	RGDV 3	none	Tomo time 3 :	0,8	Tomo time 7 :	0,1
		Bucky RGDV	none	none	Tomo time 4 :	3,2	Tomo time 8 :	0,1
		Tomo RGDV - switch related	RGDV 2	none	Time setting for input at WA X21:1 8			
For WBX11 : 9 --10 (ready) und 1--2 (format size correction contact)		*Tomo mode switch : X11:3 SL_XG_TO / Bucky RGDV : X11:1 Format + :10 Bucky ready / Tomo RGDV : X11:1 Format + :5 Tomo ready switch related X11:3 --> Bucky - Tomo remote switchover RGDVs*						

1) = has to be adjustet on site
[ ] = TDC

RGDV programming: example 4

BuckyDIAGNOST with Bucky-Controller TH / TH2 / DigitalDiagnost **Name :**	Bucky	Tomo	Bucky wall stand	Free cassette				
Data Set A : Desk :	RGDV1	RGDV2	RGDV3	RGDV4	RGDV5	RGDV6	RGDV7	RGDV8
- Room :	1	1	1	1				
- Tube :	1	1	1	1				
- Release circuit number :	do not care	do not care	do not care	do not care				
- Enable handswitch at generator desk :	yes	yes	yes	yes				
- Syncmaster present :	yes	yes	yes	yes				
- Exposure switch type :	double step	double step	double step	double step				
- Bucky format density correction :	0	0	0	0				
- Cone density correction :	0	0	0	0				
- Dose measurement input :	EZ X21	none / [EZ X21]	EZ X31	none				
- Dose measurement sensor :	Bucky amplimat	Bucky amplimat	Bucky amplimat	(Bucky amplimat)				
- Exposure series / Tomo movement :	no	no	no	no				
- Release delay :	enable	enable	enable	enable				
- Mounted radiographical controller :	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost				
- Release circuit adaptation unit :	none	none	none	none				
- Mounted tomo extension :	none	none	none	none				
- Medium II format kV correction (dose equiv. steps) :	0	0	0	0				
- Medium II format density correction (6% steps) :	0	0	0	0				
- Medium II format mAs correction (6% steps) :	0	0	0	0				
- Small II format kV correction (dose equiv. steps) :	0	0	0	0				
- Small II format density correction (6% steps) :	0	0	0	0				
- Small II format mAs correction (6% steps) :	0	0	0	0				
Data Set B :								
- Used for tomo :	no	yes	no	no				
- Used for fluoroscopy :	no	no	no	no				
- CT add on :	no	no	no	no				
- Disable time override :	no	no	no	no				
- Tube power factor :	100 %	100 %	100 %	100 %				
- kV steps :	Dose equiv. [1)]	Dose equiv. [1)]	Dose equiv. [1)]	Dose equiv. [1)]				
- mAs steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]				
- mA steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]				
- time steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]				
- Density steps :	12 % [1)]	12 % [1)]	12 % [1)]	12 %				
- Density correction (6% steps) :	0	0	0	0				
- Underexposure display :	yes	yes	yes	yes				
- Tube overload protection :	on	on	on	on				

~~Bucky / Scopo 1WB / Decade Bucky 1 (WBX11) :~~		~~Bucky / Tomo 1WA : Decade Bucky 1/2~~	~~WAX11~~	~~WAX12~~	~~Bucky / Tomo time~~			
Bucky RGDV :	RGDV1 [ ] RGDV2 [ ] RGDV3 [ ] RGDV4 [ ] RGDV5 [ ] RGDV6 [ ] RGDV7 [ ] RGDV8 [ ]	Tomo mode switch	----	----	Tomo time 1 :	----	Tomo time 5:	----
		Bucky RGDV - switch related	----	----	Tomo time 2 :	----	Tomo time 6 :	----
		Bucky RGDV	----	----	Tomo time 3 :	----	Tomo time 7 :	----
		Bucky RGDV	----	----	Tomo time 4 :	----	Tomo time 8 :	----
		Tomo RGDV - switch related	----	----	Time setting for input at WA X21:1 8			
For WBX11 : 9 --10 (ready) und 1--2 (format size correction contact)		*Tomo mode switch : X11:3 SL_XG_TO / Bucky RGDV : X11:1 Format + :10 Bucky ready / Tomo RGDV : X11:1 Format + :5 Tomo ready switch related X11:3 --> Bucky - Tomo remote switchover RGDVs*						

1) = has to be adjustet on site
[ ] = TDC

RGDV programming: example 5

BuckyDIAGNOST TS **Name :**	Bucky	Tomo	Bucky wall stand	Free cassette				
Data Set A : Desk :	RGDV1	RGDV2	RGDV3	RGDV4	RGDV5	RGDV6	RGDV7	RGDV8
- Room :	1	1	1	1				
- Tube :	1	1	1	1				
- Release circuit number :	1	1	2	(1)				
- Enable handswitch at generator desk :	yes	yes	yes	yes				
- Syncmaster present :	yes	yes	yes	no				
- Exposure switch type :	double step	double step	double step	double step				
- Bucky format density correction :	0	0	0	0				
- Cone density correction :	0	0	0	0				
- Dose measurement input :	EZ X21	none / [EZX21]	EZ X31	none				
- Dose measurement sensor :	Bucky amplimat	Bucky amplimat	Bucky amplimat	Bucky amplimat				
- Exposure series / Tomo movement :	no	yes	no	no				
- Release delay :	enable	enable	enable	enable				
- Mounted radiographical controller :	none	none	none	none				
- Release circuit adaptation unit :	1WA	1WA	1WA	none				
- Mounted tomo extension :	none	1WA	none	none				
- Medium II format kV correction (dose equiv. steps) :	0	0	0	0				
- Medium II format density correction (6% steps) :	0	0	0	0				
- Medium II format mAs correction (6% steps) :	0	0	0	0				
- Small II format kV correction (dose equiv. steps) :	0	0	0	0				
- Small II format density correction (6% steps) :	0	0	0	0				
- Small II format mAs correction (6% steps) :	0	0	0	0				
Data Set B :								
- Used for tomo :	no	yes	no	no				
- Used for fluoroscopy :	no	no	no	no				
- CT add on :	no	no	no	no				
- Disable time override :	no	no	no	no				
- Tube power factor :	100 %	100 %	100 %	100 %				
- kV steps :	Dose equiv. 1)	Dose equiv. 1)	Dose equiv. 1)	Dose eqiv. 1)				
- mAs steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)				
- mA steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)				
- time steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)				
- Density steps :	12 % 1)	12 % 1)	12 % 1)	12 %				
- Density correction (6% steps) :	0	0	0	0				
- Underexposure display :	yes	no	yes	yes				
- Tube overload protection :	on	on	on	on				

~~**Bucky / Scopo 1WB / Decade Bucky 1 (WBX11) :**~~		**Bucky / Tomo 1WA : Decade Bucky 1/2**	**WAX11**	**WAX12**	~~**Bucky / Tomo time**~~			
Bucky RGDV :	RGDV1 [ ] RGDV2 [ ] RGDV3 [ ] RGDV4 [ ] RGDV5 [ ] RGDV6 [ ] RGDV7 [ ] RGDV8 [ ]	Tomo mode switch	enable	----	Tomo time 1 :	----	Tomo time 5:	----
		Bucky RGDV - switch related	RGDV1	----	Tomo time 2 :	----	Tomo time 6 :	----
		Bucky RGDV	none	----	Tomo time 3 :	----	Tomo time 7 :	----
		Bucky RGDV	none	----	Tomo time 4 :	----	Tomo time 8 :	----
		Tomo RGDV - switch related	RGDV2	----	Time setting for input at WA X21:1 8			
For WBX11 : 9 --10 (ready) und 1--2 (format size correction contact)		*Tomo mode switch : X11:3 SL_XG_TO / Bucky RGDV : X11:1 Format + :10 Bucky ready / Tomo RGDV : X11:1 Format + :5 Tomo ready switch related X11:3 --> Bucky - Tomo remote switchover RGDVs*						

1) = has to be adjustet on site
[ ] = TDC

RGDV programming: example 6

EASYDIAGNOST including CAN controlled CS Bucky unit **Name :**	Scopo	DSI			Bucky	Tomo	Bucky wall stand	Free cassette
Data Set A : Desk :	RGDV1	RGDV2	RGDV3	RGDV4	RGDV5	RGDV6	RGDV7	RGDV8
- Room :	1	1			1	1	1	1
- Tube :	1	1			2	2	2	2
- Release circuit number :	1	2			do not care	do not care	do not care	do not care
- Enable handswitch at generator desk :	no	no			yes	yes	yes	yes
- Syncmaster present :	yes	yes			yes	yes	yes	yes
- Exposure switch type :	double step	double step			double step	double step	double step	double step
- Bucky format density correction :	0	0			0	0	0	0
- Cone density correction :	0	0			0	0	0	0
- Dose measurement input :	EZ X21	EZ X41			EZ X31	none / [EZ X31]	EZ X32	none
- Dose measurement sensor :	Scopo amplimat	photo sensor/ amplimat input			Bucky amplimat	Bucky amplimat	Bucky amplimat	(Bucky amplimat)
- Exposure series / Tomo movement :	yes	yes			no	no	no	no
- Release delay :	enable	enable			enable	enable	enable	enable
- Mounted radiographical controller :	none	none			Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost
- Release circuit adaptation unit :	1WB	1WB			none	none	none	none
- Mounted tomo extension :	none	none			none	none	none	none
- Medium II format kV correction (dose equiv. steps) :	0	1 1)			0	0	0	0
- Medium II format density correction (6% steps) :	0	0 1)			0	0	0	0
- Medium II format mAs correction (6% steps) :	0	0 1)			0	0	0	0
- Small II format kV correction (dose equiv. steps) :	0	2 1)			0	0	0	0
- Small II format density correction (6% steps) :	0	0 1)			0	0	0	0
- Small II format mAs correction (6% steps) :	0	0 1)			0	0	0	0
Data Set B :								
- Used for tomo :	no	no			no	yes	no	no
- Used for fluoroscopy :	yes	yes			no	no	no	no
- CT add on :	no	no			no	no	no	no
- Disable time override :	no	no			no	no	no	no
- Tube power factor :	100 %	100 %			100 %	100 %	100 %	100 %
- kV steps :	Dose equiv. 1)	Dose equiv. 1)			Dose equiv. 1)	Dose equiv. 1)	Dose equiv. 1)	Dose equiv. 1)
- mAs steps :	25 % 1)	25 % 1)			25 % 1)	25 % 1)	25 % 1)	25 % 1)
- mA steps :	25 % 1)	25 % 1)			25 % 1)	25 % 1)	25 % 1)	25 % 1)
- time steps :	25 % 1)	25 % 1)			25 % 1)	25 % 1)	25 % 1)	25 % 1)
- Density steps :	12 % 1)	12 % 1)			12 % 1)	12 % 1)	12 % 1)	12 %
- Density correction (6% steps) :	0	0			0	0	0	0
- Underexposure display :	yes	yes			yes	yes	yes	yes
- Tube overload protection :	on	on			on	on	on	on

Bucky / Scopo 1WB / Decade Bucky 1 (WBX11) :		~~**Bucky / Tomo 1WA : Decade Bucky 1/2**~~	~~**WAX11**~~	~~**WAX12**~~	~~**Bucky / Tomo time**~~			
Bucky RGDV :	RGDV1 [X] RGDV2 [X] RGDV3 [ ] RGDV4 [ ] RGDV5 [ ] RGDV6 [ ] RGDV7 [ ] RGDV8 [ ]	Tomo mode switch	----	----	Tomo time 1 :	----	Tomo time 5:	----
		Bucky RGDV - switch related	----	----	Tomo time 2 :	----	Tomo time 6 :	----
		Bucky RGDV	----	----	Tomo time 3 :	----	Tomo time 7 :	----
		Bucky RGDV	----	----	Tomo time 4 :	----	Tomo time 8 :	----
		Tomo RGDV - switch related	----	----	Time setting for input at WA X21:1 8			
For WBX11 : 9 --10 (ready) und 1--2 (format size correction contact)		*Tomo mode switch : X11:3 SL_XG_TO / Bucky RGDV : X11:1 Format + :10 Bucky ready / Tomo RGDV : X11:1 Format + :5 Tomo ready switch related X11:3 --> Bucky - Tomo remote switchover RGDVs*						

1) = has to be adjustet on site
[ ] = TDC

RGDV programming: example 7

BuckyDIAGNOST TH any version with Bucky-Controller Generotor equipped with / without decade adapt. unit WA Aux. for MCS (only) = RGDV4 combined with free cassette **Name :**	Bucky	Tomo	Bucky wall stand	Free cassette	MCS			
Data Set A : Desk :	RGDV1	RGDV2	RGDV3	RGDV4	RGDV4	RGDV6	RGDV7	RGDV8
- Room :	1	1	1	1	1			
- Tube :	1	1	1	1	1			
- Release circuit number :	1	1	1	1	1			
- Enable handswitch at generator desk :	yes	yes	yes	yes	yes			
- Syncmaster present :	yes	yes	yes	yes	yes			
- Exposure switch type :	double step	double step	double step	double step	double step			
- Bucky format density correction :	0	0	0	0	0			
- Cone density correction :	0	0	0	0	0			
- Dose measurement input :	EZ X21	none / [EZ X21]	EZ X31	none	EZ X22			
- Dose measurement sensor :	Bucky amplimat	Bucky amplimat	Bucky amplimat	(Bucky amplimat)	Bucky amplimat			
- Exposure series / Tomo movement :	no	no	no	no	no			
- Release delay :	enable	enable	enable	enable	enable			
- Mounted radiographical controller :	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost			
- Release circuit adaptation unit :	none	none	none	none	none			
- Mounted tomo extension :	none	none	none	none	none			
- Medium II format kV correction (dose equiv. steps) :	0	0	0	0	0			
- Medium II format density correction (6% steps) :	0	0	0	0	0			
- Medium II format mAs correction (6% steps) :	0	0	0	0	0			
- Small II format kV correction (dose equiv. steps) :	0	0	0	0	0			
- Small II format density correction (6% steps) :	0	0	0	0	0			
- Small II format mAs correction (6% steps) :	0	0	0	0	0			
Data Set B :								
- Used for tomo :	no	yes	no	no	no			
- Used for fluoroscopy :	no	no	no	no	no			
- CT add on :	no	no	no	no	no			
- Disable time override :	no	no	no	no	no			
- Tube power factor :	100 %	100 %	100 %	100 %	100 %			
- kV steps :	Dose equiv. 1)	Dose equiv. 1)	Dose equiv. 1)	Dose equiv. 1)	Dose equiv. 1)			
- mAs steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)	25 % 1)			
- mA steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)	25 % 1)			
- time steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)	25 % 1)			
- Density steps :	12 % 1)	12 % 1)	12 % 1)	12 %	12 % 1)			
- Density correction (6% steps) :	0	0	0	0	0			
- Underexposure display :	yes	yes	yes	yes	yes			
- Tube overload protection :	on	on	on	on	on			

~~Bucky / Scopo 1WB / Decade Bucky 1 (WBX11) :~~		~~Bucky / Tomo 1WA : Decade Bucky 1/2~~	~~WAX11~~	~~WAX12~~	~~Bucky / Tomo time~~			
Bucky RGDV :	RGDV1 [ ] RGDV2 [ ] RGDV3 [ ] RGDV4 [ ] RGDV5 [ ] RGDV6 [ ] RGDV7 [ ] RGDV8 [ ]	Tomo mode switch	----	----	Tomo time 1 :	----	Tomo time 5:	----
		Bucky RGDV - switch related	----	----	Tomo time 2 :	----	Tomo time 6 :	----
		Bucky RGDV	----	----	Tomo time 3 :	----	Tomo time 7 :	----
		Bucky RGDV	----	----	Tomo time 4 :	----	Tomo time 8 :	----
		Tomo RGDV - switch related	----	----	Time setting for input at WA X21:1 8			
For WBX11 : 9 --10 (ready) und 1--2 (format size correction contact)		*Tomo mode switch : X11:3 SL_XG_TO / Bucky RGDV : X11:1 Format + :10 Bucky ready / Tomo RGDV : X11:1 Format + :5 Tomo ready switch related X11:3 --> Bucky - Tomo remote switchover RGDVs*						

1) = has to be adjustet on site
[ ] = TDC

RGDV programming: example 8

BuckyDIAGNOST TH any version ***Generotor equipped with / without decade adapt. unit WA*** ***Aux. for MCS (only) = any of RGDV5 ... 8*** ***Name :***	Bucky	Tomo	Bucky wall stand	Free cassette				MCS
Data Set A : Desk :	RGDV1	RGDV2	RGDV3	RGDV4	RGDV5	RGDV6	RGDV7	RGDV8
- Room :	1	1	1	1				1
- Tube :	1	1	1	1				1
- Release circuit number :	1	1	1	1				1
- Enable handswitch at generator desk :	yes	yes	yes	yes				yes
- Syncmaster present :	yes	yes	yes	yes				no
- Exposure switch type :	double step	double step	double step	double step				double step
- Bucky format density correction :	0	0	0	0				0
- Cone density correction :	0	0	0	0				0
- Dose measurement input :	EZ X21	none / [EZ X21]	EZ X31	none				EZ X22
- Dose measurement sensor :	Bucky amplimat	Bucky amplimat	Bucky amplimat	(Bucky amplimat)				Bucky amplimat
- Exposure series / Tomo movement :	no	no	no	no				no
- Release delay :	enable	enable	enable	enable				enable
- Mounted radiographical controller :	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost				none
- Release circuit adaptation unit :	none	none	none	none				none
- Mounted tomo extension :	none	none	none	none				none
- Medium II format kV correction (dose equiv. steps) :	0	0	0	0				0
- Medium II format density correction (6% steps) :	0	0	0	0				0
- Medium II format mAs correction (6% steps) :	0	0	0	0				0
- Small II format kV correction (dose equiv. steps) :	0	0	0	0				0
- Small II format density correction (6% steps) :	0	0	0	0				0
- Small II format mAs correction (6% steps) :	0	0	0	0				0
Data Set B :								
- Used for tomo :	no	yes	no	no				no
- Used for fluoroscopy :	no	no	no	no				no
- CT add on :	no	no	no	no				no
- Disable time override :	no	no	no	no				no
- Tube power factor :	100 %	100 %	100 %	100 %				100 %
- kV steps :	Dose equiv. [1)]	Dose equiv. [1)]	Dose equiv. [1)]	Dose equiv. [1)]				Dose equiv. [1)]
- mAs steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]				25 % [1)]
- mA steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]				25 % [1)]
- time steps :	25 % [1)]	25 % [1)]	25 % [1)]	25 % [1)]				25 % [1)]
- Density steps :	12 % [1)]	12 % [1)]	12 % [1)]	12 %				12 % [1)]
- Density correction (6% steps) :	0	0	0	0				0
- Underexposure display :	yes	yes	yes	yes				yes
- Tube overload protection :	on	on	on	on				on

~~Bucky / Scopo 1WB / Decade Bucky 1 (WBX11) :~~		~~Bucky / Tomo 1WA : Decade Bucky 1/2~~	~~WAX11~~	~~WAX12~~	~~Bucky / Tomo time~~			
Bucky RGDV :	RGDV1 [ ] RGDV2 [ ] RGDV3 [ ] RGDV4 [ ] RGDV5 [ ] RGDV6 [ ] RGDV7 [ ] RGDV8 [ ]	Tomo mode switch	----	----	Tomo time 1 :	----	Tomo time 5:	----
		Bucky RGDV - switch related	----	----	Tomo time 2 :	----	Tomo time 6 :	----
		Bucky RGDV	----	----	Tomo time 3 :	----	Tomo time 7 :	----
		Bucky RGDV	----	----	Tomo time 4 :	----	Tomo time 8 :	----
		Tomo RGDV - switch related	----	----	Time setting for input at WA X21:1 8			
For WBX11 : 9 --10 (ready) und 1--2 (format size correction contact)		*Tomo mode switch : X11:3 SL_XG_TO / Bucky RGDV : X11:1 Format + :10 Bucky ready / Tomo RGDV : X11:1 Format + :5 Tomo ready switch related X11:3 --> Bucky - Tomo remote switchover RGDVs*						

1) = has to be adjustet on site
[ ] = TDC

RGDV programming: example 9

BuckyDIAGNOST TH any version ***Name :*** ***Generotor equipped with / without decade adapt. unit WA*** ***Aux. for TraumaDiagnost (only) = any of RGDV5 ... 8*** ***Aux. RGDV1 ... 4 must not be used with a Bucky TH stystem via CAN***	Bucky	Tomo	Bucky wall stand	Free cassette				Trauma
Data Set A : Desk :	RGDV1	RGDV2	RGDV3	RGDV4	RGDV5	RGDV6	RGDV7	RGDV8
- Room :	1	1	1	1				1
- Tube :	1	1	1	1				2
- Release circuit number :	1	1	1	1				1
- Enable handswitch at generator desk :	yes	yes	yes	yes				yes
- Syncmaster present :	yes	yes	yes	yes				no
- Exposure switch type :	double step	double step	double step	double step				double step
- Bucky format density correction :	0	0	0	0				0
- Cone density correction :	0	0	0	0				0
- Dose measurement input :	EZ X21	none / [EZ X21]	EZ X31	none				EZ X22
- Dose measurement sensor :	Bucky amplimat	Bucky amplimat	Bucky amplimat	(Bucky amplimat)				Scopo amplimat
- Exposure series / Tomo movement :	no	no	no	no				no
- Release delay :	enable	enable	enable	enable				enable
- Mounted radiographical controller :	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost	Bucky contr. 1 / DigitalDiagnost				none
- Release circuit adaptation unit :	none	none	none	none				none
- Mounted tomo extension :	none	none	none	none				none
- Medium II format kV correction (dose equiv. steps) :	0	0	0	0				0
- Medium II format density correction (6% steps) :	0	0	0	0				0
- Medium II format mAs correction (6% steps) :	0	0	0	0				0
- Small II format kV correction (dose equiv. steps) :	0	0	0	0				0
- Small II format density correction (6% steps) :	0	0	0	0				0
- Small II format mAs correction (6% steps) :	0	0	0	0				0
Data Set B :								
- Used for tomo :	no	yes	no	no				no
- Used for fluoroscopy :	no	no	no	no				yes
- CT add on :	no	no	no	no				no
- Disable time override :	no	no	no	no				no
- Tube power factor :	100 %	100 %	100 %	100 %				100 %
- kV steps :	Dose equiv. 1)	Dose equiv. 1)	Dose equiv. 1)	Dose equiv. 1)				Dose equiv. 1)
- mAs steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)				25 % 1)
- mA steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)				25 % 1)
- time steps :	25 % 1)	25 % 1)	25 % 1)	25 % 1)				25 % 1)
- Density steps :	12 % 1)	12 % 1)	12 % 1)	12 %				12 % 1)
- Density correction (6% steps) :	0	0	0	0				0
- Underexposure display :	yes	yes	yes	yes				yes
- Tube overload protection :	on	on	on	on				on

~~Bucky / Scopo 1WB / Decade Bucky 1 (WBX11) :~~		~~Bucky / Tomo 1WA : Decade Bucky 1/2~~	~~WAX11~~	~~WAX12~~	~~Bucky / Tomo time~~			
Bucky RGDV :	RGDV1 [ ] RGDV2 [ ] RGDV3 [ ] RGDV4 [ ] RGDV5 [ ] RGDV6 [ ] RGDV7 [ ] RGDV8 [ ]	Tomo mode switch	----	----	Tomo time 1 :	----	Tomo time 5:	----
		Bucky RGDV - switch related	----	----	Tomo time 2 :	----	Tomo time 6 :	----
		Bucky RGDV	----	----	Tomo time 3 :	----	Tomo time 7 :	----
		Bucky RGDV	----	----	Tomo time 4 :	----	Tomo time 8 :	----
		Tomo RGDV - switch related	----	----	Time setting for input at WA X21:1 8			
For WBX11 : 9 --10 (ready) und 1--2 (format size correction contact)		*Tomo mode switch : X11:3 SL_XG_TO / Bucky RGDV : X11:1 Format + :10 Bucky ready / Tomo RGDV : X11:1 Format + :5 Tomo ready switch related X11:3 --> Bucky - Tomo remote switchover RGDVs*						

1) = has to be adjustet on site

[ ] = TDC

RGDV programming: example 10

Character display on the control desk English	German	French	Spanish	Possible PC display (code 850)	Input at the PC
!	!	!	!	!	
#	#	£	£	#	
$	$	$	$	$	
%	%	%	%	%	
&	&	&	&	&	
'	'	'	'	'	
(	(	(	(	(	
)	)	)	)	)	
*	*	*	*	*	
+	+	+	+	+	
,	,	,	,	,	
-	-	-	-	-	
.	.	.	.	.	
/	/	/	/	/	
0	0	0	0	0	
1	1	1	1	1	
2	2	2	2	2	
3	3	3	3	3	
4	4	4	4	4	
5	5	5	5	5	
6	6	6	6	6	
7	7	7	7	7	
8	8	8	8	8	
9	9	9	9	9	
:	:	:	:	:	
;	;	;	;	;	
<	<	<	<	<	
=	=	=	=	=	
>	>	>	>	>	
?	?	?	?	?	
@	§	à	§	@	
A	A	A	A	A	
B	B	B	B	B	
C	C	C	C	C	
D	D	D	D	D	
E	E	E	E	E	
F	F	F	F	F	
G	G	G	G	G	
H	H	H	H	H	
I	I	I	I	I	
J	J	J	J	J	
K	K	K	K	K	
L	L	L	L	L	
M	M	M	M	M	
N	N	N	N	N	
O	O	O	O	O	
P	P	P	P	P	
Q	Q	Q	Q	Q	
R	R	R	R	R	
S	S	S	S	S	
T	T	T	T	T	
U	U	U	U	U	
V	V	V	V	V	
W	W	W	W	W	
X	X	X	X	X	
Y	Y	Y	Y	Y	
Z	Z	Z	Z	Z	
[	Ä	.	i	[	
\	Ö	ç	Ñ	\	
]	Ü	§	¿	]	
^	^	^	^	^	
_	_	_	_	_	
'	'	'	'	'	
a	a	a	a	a	
b	b	b	b	b	
c	c	c	c	c	
d	d	d	d	d	
e	e	e	e	e	
f	f	f	f	f	
g	g	g	g	g	
h	h	h	h	h	
i	i	i	i	i	
j	j	j	j	j	
k	k	k	k	k	
l	l	l	l	l	
m	m	m	m	m	
n	n	n	n	n	
o	o	o	o	o	
p	p	p	p	p	
q	q	q	q	q	
r	r	r	r	r	
s	s	s	s	s	
t	t	t	t	t	
u	u	u	u	u	
v	v	v	v	v	
w	w	w	w	w	
x	x	x	x	x	
y	y	y	y	y	
z	z	z	z	z	
{	ä	é	▪	{	Alt +123
¦	ö	ù	ñ	¦	Alt +124
}	ü	é	Ç	}	Alt +125
~	ß	-	~	~	Alt +126
				∆	Alt +127
◢	◢	◢	◢	á	Alt +160
■	■	■	■	í	Alt +161
⊦	⊦	⊦	⊦	ó	Alt +162
£	£	£	£	ú	Alt +163
▪	▪	▪	▪	ñ	Alt +164
§	§	§	§	º	Alt +167
⦀	⦀	⦀	⦀	¿	Alt +168
‖	‖	‖	‖	®	Alt +169
≣	≣	≣	≣	¬	Alt +170
≡	≡	≡	≡	½	Alt +171
					Alt +172
					Alt +173
					Alt +174
					Alt +175
°	°	°	°	░	Alt +176
±	±	±	±	▒	Alt +177
²	²	²	²	█	Alt +178
À	À	À	À	└	Alt +192
Á	Á	Á	Á	┴	Alt +193
Â	Â	Â	Â	┬	Alt +194
Ã	Ã	Ã	Ã	├	Alt +195
Ä	Ä	Ä	Ä	─	Alt +196
Å	Å	Å	Å	┼	Alt +197
Æ	Æ	Æ	Æ	ã	Alt +198
Ç	Ç	Ç	Ç	Ã	Alt +199
È	È	È	È	╚	Alt +200
É	É	É	É	╔	Alt +201
Ê	Ê	Ê	Ê	╩	Alt +202
Ë	Ë	Ë	Ë	╦	Alt +203
Ì	Ì	Ì	Ì	╠	Alt +204
Í	Í	Í	Í	═	Alt +205
Î	Î	Î	Î	╬	Alt +206
Ï	Ï	Ï	Ï	¤	Alt +207
				δ	Alt +208
Ñ	Ñ	Ñ	Ñ	Ð	Alt +209
Ò	Ò	Ò	Ò	Ê	Alt +210
Ó	Ó	Ó	Ó	Ë	Alt +211
Ô	Ô	Ô	Ô	È	Alt +212
Õ	Õ	Õ	Õ	ı	Alt +213
Ö	Ö	Ö	Ö	í	Alt +214
				î	Alt +215
Ø	Ø	Ø	Ø	ï	Alt +216
Ù	Ù	Ù	Ù	┘	Alt +217
Ú	Ú	Ú	Ú	┌	Alt +218
Û	Û	Û	Û	█	Alt +219
Ü	Ü	Ü	Ü	▄	Alt +220
Ý	Ý	Ý	Ý	¦	Alt +221
				ì	Alt +222
ß	ß	ß	ß	▀	Alt +223
à	à	à	à	Ó	Alt +224
á	á	á	á	β	Alt +225
â	â	â	â	Ô	Alt +226
ã	ã	ã	ã	Ò	Alt +227
ä	ä	ä	ä	õ	Alt +228
å	å	å	å	Õ	Alt +229
æ	æ	æ	æ	µ	Alt +230
ç	ç	ç	ç	Þ	Alt +231
è	è	è	è	þ	Alt +232
é	é	é	é	Ú	Alt +233
ê	ê	ê	ê	Û	Alt +234
ë	ë	ë	ë	Ù	Alt +235
ì	ì	ì	ì	ý	Alt +236
í	í	í	í	Ý	Alt +237
î	î	î	î	▪	Alt +238
ï	ï	ï	ï	′	Alt +239
				▪	Alt +240
ñ	ñ	ñ	ñ	±	Alt +241
ò	ò	ò	ò	=	Alt +242
ó	ó	ó	ó	¾	Alt +243
ô	ô	ô	ô	¶	Alt +244
õ	õ	õ	õ	§	Alt +245
ö	ö	ö	ö	÷	Alt +246
				¸	Alt +247
ø	ø	ø	ø	°	Alt +248
ù	ù	ù	ù	¨	Alt +249
ú	ú	ú	ú	·	Alt +250
û	û	û	û	ı	Alt +251
ü	ü	ü	ü	³	Alt +252
ý	ý	ý	ý	²	Alt +253
				▪	Alt +254
					Alt +255

List of characters

		Chamber 1	Chamber 2	Chamber 3	Chamber 4	Chamber 5
Data Set 1	Film:	....	....	....	....	....
	Screen:	....	....	....	....	....
	Chamber:	....	....	....	....	....
	Cassette:	....	....	....	....	....
	Sys.corr.:	....	....	....	....	....
	Corr. factor:	....	....	....	....	....
Data Set 2	Film:	....	....	....	....	....
	Screen:	....	....	....	....	....
	Chamber:	....	....	....	....	....
	Cassette:	....	....	....	....	....
	Sys.corr.:	....	....	....	....	....
	Corr. factor:	....	....	....	....	....
Data Set 3	Film:	....	....	....	....	....
	Screen:	....	....	....	....	....
	Chamber:	....	....	....	....	....
	Cassette:	....	....	....	....	....
	Sys.corr.:	....	....	....	....	....
	Corr. factor:	....	....	....	....	....
Data Set 4	Film:	....	....	....	....	....
	Screen:	....	....	....	....	....
	Chamber:	....	....	....	....	....
	Cassette:	....	....	....	....	....
	Sys.corr.:	....	....	....	....	....
	Corr. factor:	....	....	....	....	....
Data Set 5	Film:	....	....	....	....	....
	Screen:	....	....	....	....	....
	Chamber:	....	....	....	....	....
	Cassette:	....	....	....	....	....
	Sys.corr.:	....	....	....	....	....
	Corr. factor:	....	....	....	....	....

Device interface 1

RGDV key 1 :	
RGDV key 2 :	
RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....

RGDV key 1 :	
RGDV key 2 :	
RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....

RGDV key 1 :	
RGDV key 2 :	
RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....

RGDV key 1 :	
RGDV key 2 :	
RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....

Device interface 2

RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....
APR 7	APR 8 ....

RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....
APR 7	APR 8 ....

RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....
APR 7	APR 8 ....

RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....
APR 7	APR 8 ....

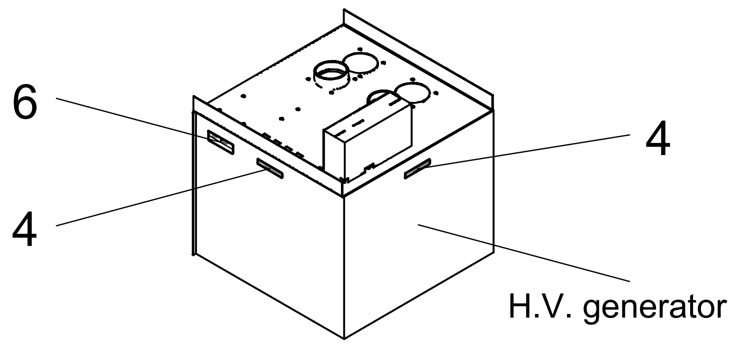
Device interface 3

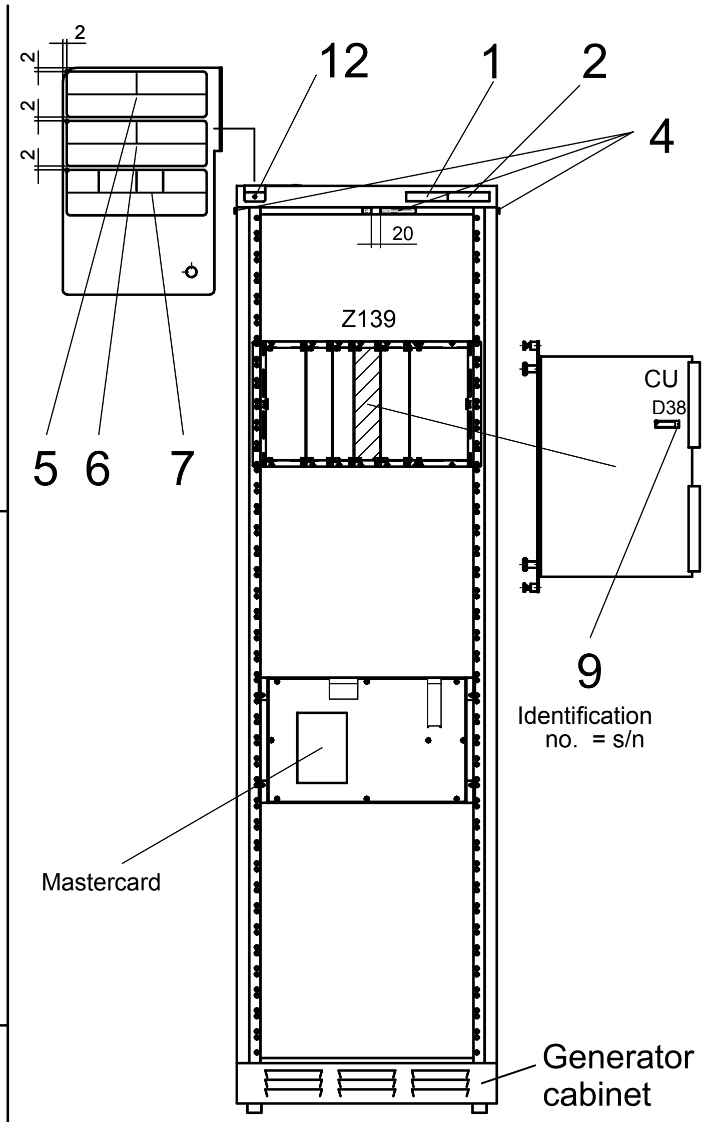
RGDV key 1 :	
RGDV key 2 :	
RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....
APR 7	APR 8 ....

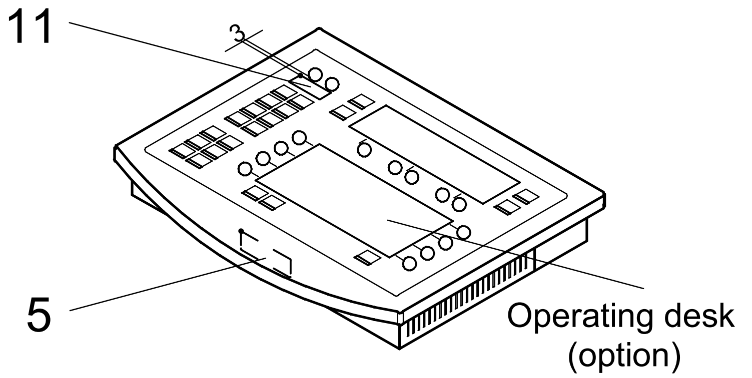
RGDV key 1 :	
RGDV key 2 :	
RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....
APR 7	APR 8 ....

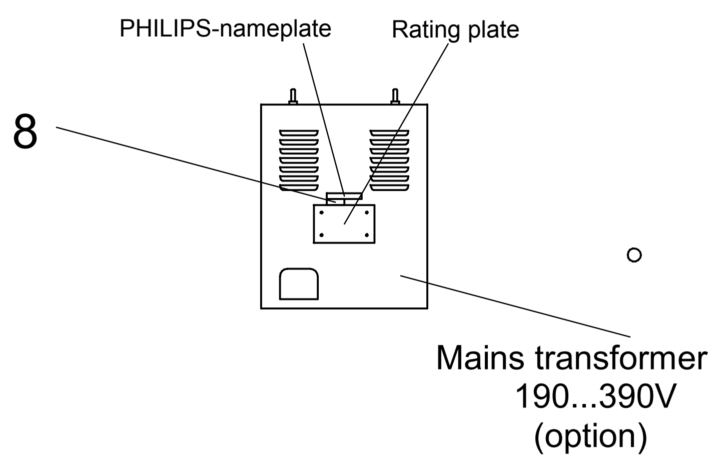
RGDV key 1 :	
RGDV key 2 :	
RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....
APR 7	APR 8 ....

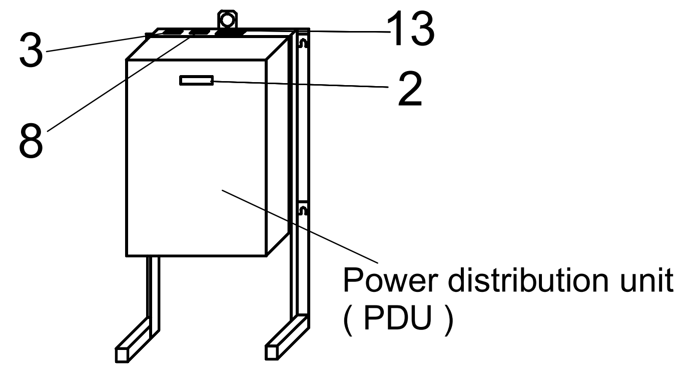
RGDV key 1 :	
RGDV key 2 :	
RGDV	
APR 1	APR 2 ....
APR 3	APR 4 ....
APR 5	APR 6 ....
APR 7	APR 8 ....

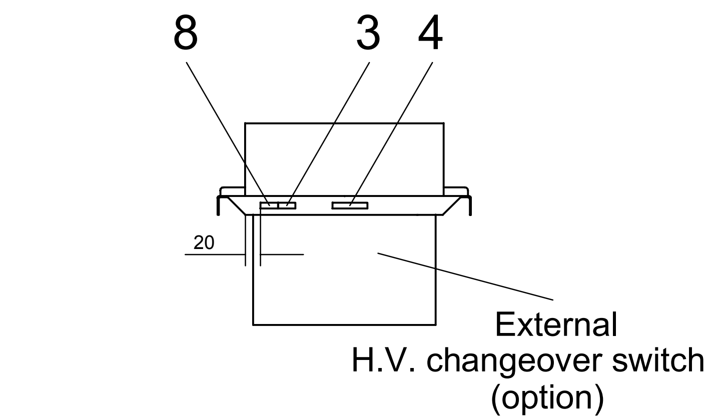












1 OPTIMUS 50

1 OPTIMUS 65

1 OPTIMUS 80

2 PHILIPS — PHILIPS MADE IN GERMANY

3 Philips Medical Systems Development and Manufacturing Centre Röntgenstrasse 24 D-22335 Hamburg/Germany

4 CAUTION — HAZARD FOR LIVE AND/OR MOVING PARTS. ATTENTION WHEN SERVICING ENERGIZED EQUIPMENT. OBSERVE THE SERVICE-MANUAL.

5 -X-RAY CONTROL- type 9890 000 0200x s/n xx xxxx OPTIMUS xxx — Philips Medical Systems Development and Manufacturing Centre Röntgenstrasse 24 D-22335 Hamburg/Germany

6 -X-RAY HV GENERATOR- type 9890 000 0200x s/n xx xxxx OPTIMUS xxx — Philips Medical Systems Development and Manufacturing Centre Röntgenstrasse 24 D-22335 Hamburg/Germany

7 50 KW — 3 ~ 50/60 HZ 400V 480V | 10 A 8 A | 145 A 120 A

7 65 KW — 3 ~ 50/60 HZ 400V 480V | 10 A 8 A | 190 A 160 A

7 80 KW — 3 ~ 50/60 HZ 400V 480V | 10 A 8 A | 230 A 190 A

8 type Produktname s/n Fabr. Nr. code Code Nr.

9 SN.

Regulation- dependant labels

5 -X-RAY CONTROL- type 9890 000 0200x s/n xx xxxx OPTIMUS xxx — Philips Medical Systems Development and Manufacturing Centre Röntgenstrasse 24 D-22335 Hamburg/Germany — CERTIFICATION This product complies with the Performance Standard under the Radiation Control for Health and Safety Act of 1968, applicable at date of manufacture. Manufactured: MONAT JAHR — HHS

6 -X-RAY HV GENERATOR- type 9890 000 0200x s/n xx xxxx OPTIMUS xxx — Philips Medical Systems Development and Manufacturing Centre Röntgenstrasse 24 D-22335 Hamburg/Germany — CERTIFICATION This product complies with the Performance Standard under the Radiation Control for Health and Safety Act of 1968, applicable at date of manufacture. Manufactured: MONAT JAHR — HHS

7 50 KW — 3 ~50/60 HZ 400V 480V | 10 A 8 A | 145 A 120 A — - X-RAY EQUIPMENT - CLASSIFIED BY UNDERWRITERS LABORATORIES INC WITH RESPECT TO ELECTRICAL FIRE. SHOCK AND MECHANICAL HAZARDS ONLY 641B SA LR 37323 C — UL CSA

7 65 KW — 3 ~50/60 HZ 400V 480V | 10 A 8 A | 190 A 160 A — - X-RAY EQUIPMENT - CLASSIFIED BY UNDERWRITERS LABORATORIES INC WITH RESPECT TO ELECTRICAL FIRE. SHOCK AND MECHANICAL HAZARDS ONLY 641B SA LR 37323 C — UL CSA

7 80 KW — 3 ~50/60 HZ 400V 480V | 10 A 8 A | 230 A 190 A — - X-RAY EQUIPMENT - CLASSIFIED BY UNDERWRITERS LABORATORIES INC WITH RESPECT TO ELECTRICAL FIRE. SHOCK AND MECHANICAL HAZARDS ONLY 641B SA LR 37323 C — UL CSA

11 WARNING: THIS X-RAY UNIT MAY BE DANGEROUS TO PATIENT AND OPERATOR UNLESS SAFE EXPOSURE FACTORS AND OPERATING INSTRUCTIONS ARE OBSERVED. — HHS

12 Certified Component Labels Here

13 3~ 50/60 Hz 400 V I 1 A 480 V 9 A — PDU

Labelling

FAULT FINDING

TEXT

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2.	**Notes**	**3–2**
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DRAWINGS

Central rack, service aid	3Z–1
Comparison release decades – CP generators <–> OPTIMUS	3Z–21

1. Tools

- Service engineer mechanical tool kit
- mAs meter
- Multimeter
- Digital oscilloscope with 2-beam memory
- PC incl. 3.5” FDD, HW-dongle, serial interface cable, free RAM ≥ 590KB
- Service software ”XRGSCOPE” Version 2.2 or higher
- Recommended PLCC extraction tool (AMP 822154-1) 2422 487 89772

2. Notes

Warning!

After the generator has been switched OFF, hazardous voltages are still applied to the D.C. intermediate circuits of the converter, the rotor control and the mA control.
These voltages are usually discharged within 2 minutes to values which are no longer dangerous.
For that reason always wait for a minimum of 2 minutes before starting any electrical work always after the generator has been switched OFF.

Note
Permanently interested in quality improvement of PMS products we depend on information from the field. Therefore please send us the current generator logfile information:

Please download the generator errorlog logfile in zipped format as described in chapter 4.4 “Saving data on disk and restoring data”.

The filename must express the generator release and generator serial number.
E. g. “35012105.tdl” for Rel. “3.5” and serial number “012105”.

Send this file containing the serial number of the generator and customer data attached to an E-Mail to:

Carsten Mais
Service Innovation Generators
PMS DMC Hamburg

E-Mail: Carsten.Mais@philips.com

Appreciate your help and many thanks in advance!

3. Strategy

There are 3 categories of errors:

1. The generator cannot be switched ON at all or only for a short time.
   See ⇒ 5. ”Initialization phase of the generator”
   ⇒ 6.1. ”Switch ON not possible”

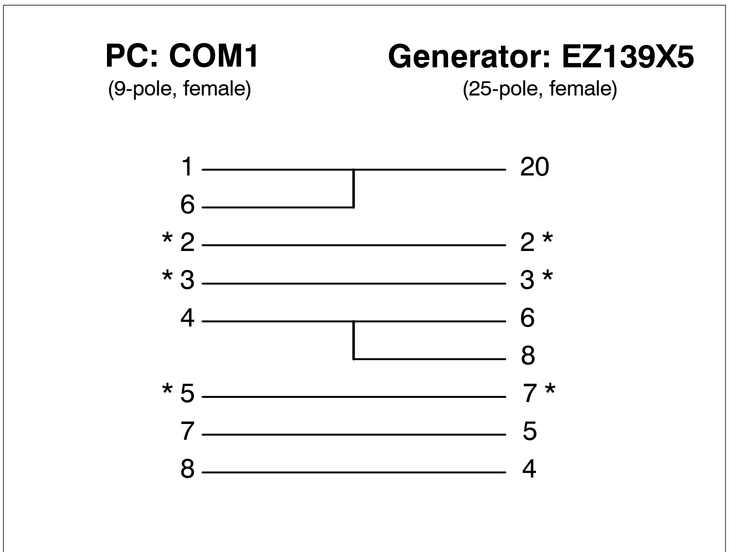
2. The generator can be switched ON but no error numbers are displayed on the operating desk.
   For fault finding use the service PC.
   See ⇒ 4.1. ”Connecting the service PC”
   ⇒ 5. ”Initialization phase of the generator”
   ⇒ 7. ”Error numbers”

3. Error messages are displayed on the desk.
   For fault finding use the service PC.
   See ⇒ 4.1. “Connecting the service PC”
   ⇒ 7. “Error numbers“

4. Service-PC

4.1. Connection

- Switch the generator ON.
- Provide the service PC with the hardware key and switch it ON.
  The hardware key provides access to special program settings and to menu ***”Faultfind”.***
  Standard programming is possible without a hardware key.
- Connect the PC to X5 on EZ139 CENTRAL UNIT CU via a serial data cable:
  (A 5m long data cable can be ordered via 12NC: 4512 130 56931)



* = sufficient for communication RAD / RF

4.2. Operation

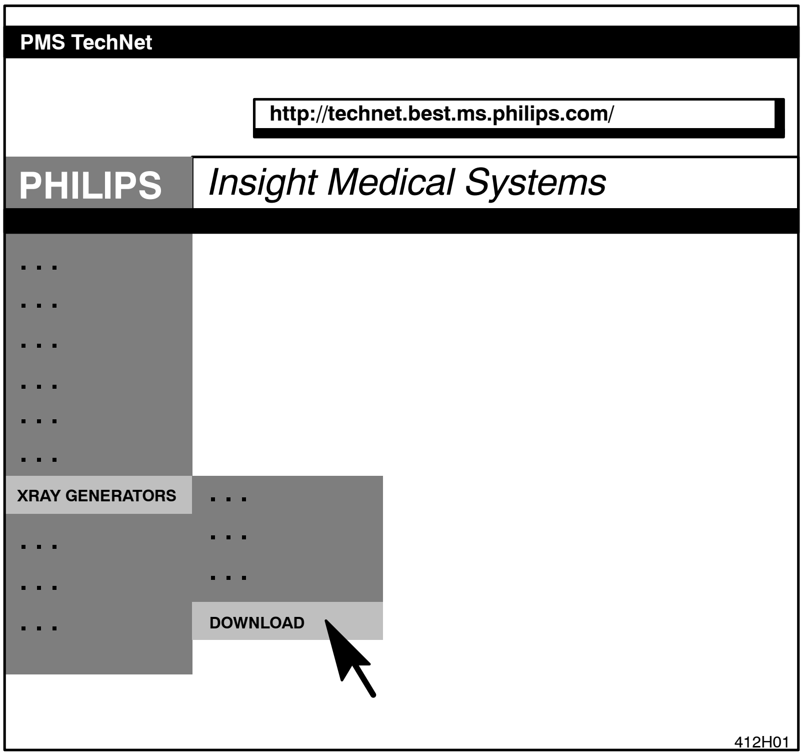
For installation of generator firmware and newest service tools see ”REPLACEMENT” chapter ”Exchange of firmware ...”.

- Call the program with ***<xrgscope>*** *or with* ***<xrgscope lcd>*** *for PCs with LCD screen.*
- Enter your password.

  The following menu line appears:

File	***OPTIMUS***	***Select Unit***	***Options***	***Help***

Current data files, for instance, for online help, tube types, APR programming are available in the PHILIPS-Intranet. Use path: ***http://technet.best.ms.philips.com/*** and pull down menu as shown below.



If you call the installation program with **<xrgscope ?>** the possible starting parameters for the service program are listed.

4.3. Menu "*OPTIMUS*" structure

OPTIMUS (Release 3.5)

- ***Program***
  - *Date and Time*
  - *Mains Data*
  - *Tubes*
    - *Tube 1 ... 3*
      - *Tube 1 ... 3 Data Set*
      - *Tube 1 ... 3 Speed Selection*
    - *Tube Limits*
    - *Capacitance Tube Connection*
    - *Tube Operating Modes*
    - *Disable Tube*
  - *Registration Devices*
    - *RGDV 1 ... 8*
      - *Data Set A*
      - *Data Set B*
    - *RGDV Interface Assignments*
      - *Bucky/Tomo 1WA ... 2WA*
        - *Decade Bucky 1 (X11)*
        - *Decade Bucky 2 (X12)*
        - *Tomo Time*
      - *Bucky/SCOPO 1WB*
  - *Dose Rate Control*
    - *AMPLIMAT*
      - *Sensitivity*
      - *Chamber 1 ... 5*
        - *Data Set 1 ... 5 [ ] Data Set changes / Input ok*
    - *Image Intensifier [ ]*
    - *Fault Exposure Detection*
      - *AEC*
      - *TDC*
    - *CONT [ ]*
  - *Fluoroscopy Curves [ ]*
  - *Application Limits [ ]*
    - *X-Mode Limits read only*
    - *THORAVISION Limits read only*
    - *Overload dependent Limits [ ]*

- *Human Interface*
  - *Select Language*
  - *APR Data Set*
    - *Select APR Data Set*
    - *Change APR Data Set*
    - *Inquire APR Assignments*
  - *RGDV related Assignments*
    - *RGDV 1 ... 8*
      - *Predefined Assignment*
      - *Manual Assignment*
        - *APR Assignment*
          - *Select Menu*
          - *Assign APR*
        - *APR Deassign*
          - *Select Menu*
          - *Deassign APR*
        - *Menu Assignment*
          - *Select Menu*
          - *Assign Menu*
        - *Delete Menu*
        - *Move Menu*
        - *Rename Menu*
      - *External APR Assignments*
        - *Device Interface 1*
        - *Device Interface 2*
        - *Device Interface 3*
  - *APR modifiable by User*

- ***Adjust***
  - *Tube Adaptation*
  - *CAN Auto Configuration*
  - *Area Exposure Product*
    - *Specific Yield of Tubes*
      - *Specific Yield of Tubes 1 ... 3*
    - *Add Filter Correction Tables*
      - *2 mm Al*
      - *1 mm Al + 0.1 mm CU*
      - *1 mm Al + 0.2 mm CU*
    - *Wedge Filter Correction Table*
      - *Wedge 1*
      - *Wedge 2*
      - *Finger Wedge*
  - *Dose Rate Control [ ]*
    - *TDC AMPLIMAT (Do not change the values without order from DMC Hamburg!)*
    - *Amplification Gain*
      - *TDC*
      - *CONT*
    - *CONT kV mA manual*
  - *Boost Adaptation [ ]*

- ***Accept***
  - *Backup [ ]*
    - *RGDV related Assignments*
      - *RGDV 1 ... 8*
        - *APR Assignments*
    - *CU Complete*
  - *Restore [ ]*
    - *RGDV related Assignments*
      - *RGDV 1 ... 8*
        - *APR Assignments*
    - *CU Complete*
  - *Inspect*
    - *Tube 1 Statistic*
    - *Tube 2 Statistic*
    - *Tube 3 Statistic*
      - *Show Tube Statistic*
      - *Reset Tube Statistic [ ]*
    - *Generator Statistic (not used)*
    - *Type of Tube 1 ... 3*

- ***Faultfind*** *[ ]*
  - *Power ON Results*
    - *Options*
    - *Internal CAN Configuration*
    - *SW/HW-Versions*
  - *Logging Table*
    - *Error Log*
      - *Error Log Index*
      - *Select Error Detail*
      - *Error Log Detail*
        - --- > *Error Detail of CU*
          - *Error Info*
          - *Program Trace*
        - --- > *Error Detail of kV*
          - *Error Info*
          - *Error Trace*
          - *Error HW Set Values*
          - *Error Read HW Values*
          - *Error Specific Information*
        - --- > *Error Detail of mA*
          - *Error Info*
          - *Actual Status*
          - *Status Trace*
          - *HW Set Values*
          - *Read HW Values*
          - *Specific Information*
      - *Error Log Clear*
    - *X-Ray Log*
      - *Tube Temperature Supervision Logging*
        - *Tube Temperature Supervision Temperature Log*
        - *Tube Temperature Supervision Load Log*
        - *Tube Temperature Supervision Error Log*
      - *Dose Rate Control Logging*
        - *Read Actual Status*
        - *None Automatic Technique Calculation*
        - *AEC*
          - *AEC Calculation*
          - *AEC Trace*
        - *TDC*
          - *TDC Calculation*
          - *TDC Trace*
        - *CONT*
          - *CONT Calculation Start Value*
          - *CONT Calculation Curve*
          - *CONT Trace*
    - *CU Trace*
  - *Advanced Checks*
- ***Quit***

FU-kV *[ ]*

- ***Adjust***
  - *IGBT Pulse Width Correction*
- ***Faultfind***
  - *Power ON Results*
    - *Read Configuration*
  - *Logging Tables*
    - *Read Trace*
    - *Read Error* *(Only at current error with contents)*
      - *Error: Info*
      - *Error: Trace*
      - *Error: HW Set Values*
      - *Error: Read HW Values*
      - *Error: Specific Information*
  - *Functional Test*
    - *Test Watchdog*
    - *Test DAC-ADC*
    - *Test Converter*
    - *Switch Error Handling*
  - *Monitoring*
    - *Measure Temperatures*
    - *kV Measurements*
    - *Converter Measurements*
    - *Read 8 Bit Port*
    - *Read 16 Bit Port*
    - *Read Memory*
- ***Quit***

FU-mA *[ ]*

- ***Program***
  - *Read Focus Limits*
- ***Faultfind***
  - *Logging Tables*
    - *Read Actual Status*
    - *Read Status Trace*
    - *Read Error* *(Only at current error with contents)*
      - *Error: Info*
      - *Error: Actual Status*
      - *Error: Status Trace*
      - *Error: HW Set Values*
      - *Error: Read HW Values*
      - *Error: Specific Information*
  - *Functional Tests*
    - *Test Watchdog*
  - *Monitoring*
    - *Read I_f Nominal*
    - *Read I_f Actual*
    - *Read Intermed Circuit Voltage*
    - *Read I_e Measurement Trace*
    - *Read 8 Bit Port*
    - *Read 16 Bit Port*
    - *Read Memory*
  - *Read I_e Corrections*
  - *Adaptation Results*
    - *Select Adaptation Table for Reading*
    - *Read Previously Selected Adaptation Table*
- ***Quit***

[ ] = A hardware key is required

4.4. Saving data on disk and restoring data

All configuration data and logging tables are stored in battery-buffered CMOS areas of the CU board.

Therefore, these data have to be saved on disk as a backup.

In case data get lost they can easily be restored in the CMOS areas after the error source has been eliminated.

4.4.1. PC and generator settings to avoid problems

Optimus RAD release 3.x CMOS data are up/downloaded in one string without handshake.

Any kind of interruption can cause the loading process to fail.

Problems occur mainly during the download to the PC.

A download file which is not complete cannot be used as a safety backup file.

4.4.2. Preparation of the service PC to guarantee a safe loading process

Start XRGSCOPE always from DOS if possible.

When using any WINDOWS version:

- Switch OFF all screensavers.
- Do not run other programs.
- Do not insert any CD in the drive.

Any kind of power management of the PC hardware (BIOS) as well as the windows power management should be switched OFF.
If the PC is connected to mains power some of these might be automatically OFF.

4.4.3. Preparation of the generator

Preparation of generators without a CAN interface:

- Switch ON the generator.
  The loading process can be started once relay ENK1 has been energized.

Preparation of generators which are connected via a CAN interface:

- BuckyDiagnost TH and TH2
- DigitalDiagnost
- Thoravision
- EasyDiagnost with bucky unit

- Switch OFF the generator.
- Disconnect the following plugs:

System	**Connector**		
	EZX23 signal bus	**EZX42 or EZX42-1 system CAN**	**EZX43 or EZX43-1 system CAN**
BukyDiagnost TH / TH2	X		X
DigitalDiagnost	X	X	X
Thoravision	X	X	X
EasyDiagnost with Bucky unit	X	X	X

- Switch ON the generator.

Note
The download procedure must not be started before relay ENK1 has been energized at least 2 minutes after the generator has been switched ON.

Note
In case of mailing CU complete download files or any other xxx.tdl files use a zipped file format. These files are ASCII files which might be destroyed while being mailed.

4.4.4. Saving of data

- Select menu:
  ACCEPT/ BACKUP/ **CU COMPLETE**
- Store the data on floppy disk ”Generator configuration data“ found in the service documentation:

Default file name:	cubackup.tdl
Recommended file name:	s/n of the generator, e.g. cu012105.tdl
File size:	approx. 500–700kB
Transfer time:	approx. 8min.

- Recommendation:

  Additionally save the APR programming individually for each RGDV via the menu:
  ACCEPT/ BACKUP/ RGDV RELATED ASSIGNMENTS/ RGDV 1 ... 8/ **APR ASSIGNMENT**

  Store them with the SAVE function <F3>–key on floppy disk.

  File name: apr_bak#.tdl #= RGDV – number

  Since release 3 assignments of film/screen combinations to the individual APRs are saved in this procedure!

- Recommendation:

  Additionally save the programmings for the film/screen combinations via the menu:
  PROGRAM/ DOSE RATE CONTROL/ AMPLIMAT/ CHAMBER 1 ... 5/ **DATA SET 1 ... 5** (manual processing)

  Store them with the SAVE function <F3>–key on floppy disk.

  Recommended file name: drc##.tdl ## = chamber and data set number

4.4.5. Restoring of data

- Select menu:
  ACCEPT/ RESTORE/ **CU COMPLETE**
- Restore the data from floppy disk.
  Transfer time approx. 15min ... 50min.
- Reset the generator.
- Program date and time.

Most of the programmings and logging tables can also be stored via the SAVE-function <F3>-key of XRGSCOPE.

Some programmings can be restored via the LOAD-function <F4>-key.

- For service use, only keep the latest version of the backup.
- Never use a complete backup for a different generator, only if the hardware, firmware and option configuration are identical.
- If backups are used from other generators it is very important to carry out the adjustment of the "factor for duty cycle" as described in section 6 "ADJUSTMENTS", chapter 2.5.
- APR backups can also be loaded into other generators but take care about the release. Use APR manager to translate APR files into the required release format.
  Because specific kV and mA reductions are also transferred, load APR backups only in generators of the same or a lower power class.

5. Initialization phase of the generator

5.1. Start-up sequence

Switch ON of the generator.

|
V
Pulling-up of ENK2.
|
V
Selftest of ...

| ... control desk C ---> all display elements are switched ON for a short moment

| ... central unit EZ139

| ... kV control EZ130 ---> voltage E is measured in the D.C.. intermediate circuit

| ... mA control EZ119

| ... basic interface EZ150

| ... rotor control EY

| ... universal I/O EWA/B 102

|

| *Indicating device: The red status LED of the associated printed-circuit board or assembly is illuminated.*

|
V
After successful selftest the status LEDs blink.

|
V
The central unit establishes connection to each functional unit via the CAN bus.

|

| *Indicating device: The red status LED of the associated printed-circuit board or assembly grows dark.*

|
V
ENK1 is switched ON.

|
V
The generator is internally ready.

|
V
The external ready circuits are checked ---> unit ready, door contact closed, thermal contact of the tube closed, tube not overloaded

|
V
The green READY lamp in the operating desk is illuminated. ===> **The generator is in the READY state.**

5.2. Program status displayed on the operating panel

PHILIPS OPTIMUS		

- No tube data loaded yet.
- No RGDVs programmed yet.
- No communication between desk and CU.
- Possible error entries:
  00B3, 00B6, 00BA ... F, 00B0, 00BT, 00BX, 00CJ, 00L1, 00PE, 00XB, 00XL, 03FD

70kV	32.0mAs	Test

- Tube data loaded.
- Selected focus not adapted.

70kV	32.0mAs	Adap

- Status after calling up the adaptation mode.

40kV	00.0mAs	Adap

- Start phase of adaptation mode.
  After the READY signal appears the adaptation can be started up with the release switch.
- Possible error entries after adaptation:
  00BU, 00BV, 00X6

70kV	320mAs	100ms

- Selected focus is adapted.
- AEC / TDC technique:
  For the selected RGDV no measuring unit has been assigned yet.

70kV	0 ◢	def1

- For the selected RGDV no film/screen combination has been programmed yet.

Test APR		

- No APR data have yet been loaded onto the selected RGDV.

81kV	0 ◢	B100
skull axial		crâne axial
Schädel ax.		cráneo axial

- Ready status.
  An APR with AEC technique has been selected.

6. Switch-ON problems

6.1. Switch-ON not possible

See drawings: Z1-2.1 / 2.2 / 2.3

Z2-2

H1 on PCB EN100 is **not** illuminated

Error sources:

- ENF1 was released.
  For fault finding look in the error buffer.
- ENF1 is not switched ON.
- Mains voltage, especially phase L3, is not present.
- ENF2 was released.
  Check: Low-voltage supply
  Filament circuit
  Tube extension
  Rotor control
  External current consumers
- ENF2 is not switched ON.
- PCB EN100 or its connections are not okay.

H1 on PCB EN100 is illuminated

Error sources:

- The EMERGENCY OFF circuit is open.
- The operating desk is not connected.

6.2. No start up

Error sources:

- EN100 V1 is defective.
  The generator receives a continuous reset via signal: reset sw/.
  All red LEDs of the generator are illuminated.
  Also see Z1-2.1.
  Test: Remove link EZX44:14 --- EZX44:6.
- No boot PROM present: EZ139 D3 (see 5Z-1).
- Flash PROMs EZ139 D4/D5 not correctly loaded.

7. Error numbers

7.1. Error classification

Errors:

- Errors are indicated by 4 digits.

- The first two digits indicate the **F**unctional **U**nit FU reporting the error.

  Example:
  00xx = CU-functional unit is concerned
  02xx = kV-functional unit is concerned
  03xx = mA-functional unit is concerned

- The last two digits indicate the error symptom.

Displayed errors (Errors and Fatal errors) :

- These errors are indicated on the display of the operating desk for the customer.
  Not all fatal errors come up on desk, use PC.

- The customer must call the service.
  The customer can inform the service about the respective error number and the service can order the spare parts needed at an early stage of the maintenance procedure.

Not displayed errors (Warnings) :

- These errors are not relevant for the customer.

- In case an error of this category occurs frequently within a certain period of time, a displayed error can be generated.

7.2. Error list

Sources of error codes indicated in the first two digits decimally (hexadecimally):

Error code dec (hex)	FU (Function Unit)	Description
00xx	CU	central unit EZ139
01xx	FU_DRC	– dose rate control, control physically located on CU EZ139 – parts of basic interface FU_CIE EZ150 also involved (Amplimat) – FU_DRC also handles fluoro kV control EZ130
02xx	FU_kV	kV control EZ130
03xx	FU_mA_a	– 1st mA control EZ119 – handles 2 filaments
07xx	FU_CIE	central interface extension EZ150 basic interface
08xx	FU_HI_a	human interface 1: C300
10xx (0Axx)	FU_RC_a	1st rotor control high speed EY100
13xx (0Dxx)	FU_ADAP_a	adapter decade cable for 4 aux. units RAD WA/1WA or WA/1WA102
14xx (0Exx)	FU_ADAP_b	adapter decade cable for 4 aux. units RAD 2WA or 2WA102
15xx (0Fxx)	FU_ADAP_c	adapter decade cable for 4 aux. units R/F WB/1WB or WB/1WB102

Error classes: **F**atal error, **E**rror, **W**arning

Error code	Error class	Error text	FU
00B0	ERROR	CPU: Error in application data service interface	CU
00B1	WARNING	CPU: IIM was not expected by gen_order_list	CU
00B2	WARNING	CPU: HI order is not expected – NO Member in display_tab	CU
00B3	ERROR	NVRAM: Data language selector is invalid	CU
00B4	WARNING	CPU: Message invalid in ADopmes	CU
00B5	WARNING	CPU: Inputparameter out of range in ADsynta	CU
00B6	ERROR	NVRAM: FU adap data for DI are invalid	CU
00B7	ERROR	CPU: Message cannot be sent	CU
00B8	ERROR	NVRAM: Tomo mode switch cannot be enabled	CU
00BA	WARNING	NVRAM: Data of RGDV are invalid	CU
00BB	WARNING	NVRAM: Basedata of RGU are invalid	CU
00BC	WARNING	NVRAM: Statedata of RGU are invalid	CU
00BD	WARNING	NVRAM: Data of APR are invalid	CU
00BE	WARNING	NVRAM: Data of active RGU are invalid	CU
00BF	WARNING	NVRAM: Data of RGKeys are invalid	CU
00BG	ERROR	APR: No more lowest level menus available	CU
00BH	ERROR	APR: Display position collision	CU
00BI	ERROR	APR: Menu / APR mismatch in same level	CU
00BJ	ERROR	APR: Menu name not found	CU
00BK	ERROR	APR: APR is assigned to a different RGDV	CU
00BL	ERROR	APR: Menu name already exists	CU
00BM	ERROR	APR: Max. display position reached	CU
00BN	ERROR	APR: APR not found in this menu	CU
00BO	WARNING	NVRAM: Data of menu tree are invalid	CU
00BQ	ERROR	CPU: APR cannot be modified	CU
00BR	ERROR	CPU: APR is not assigned to an RGDV	CU
00BS	ERROR	APR: The RGDV of the APR is not ready for operation	CU
00BT	WARNING	NVRAM: Data of APR characteristics are invalid	CU
00BU	WARNING	Adaptation paused due to missing load	CU
00BV	WARNING	CPU: TTS status message during adaptation	CU

Error code	Error class	Error text	FU
00BW	ERROR	APR: APR not accepted by general calculation	CU
00BX	WARNING	NVRAM: Variofocus allowed invalid	CU
00BY	WARNING	RGDV order without active RGDV	CU
00CB	WARNING	CONF: Received IIM #1#2H unknown	CU
00CC	WARNING	CAN: Frame-repeat-counter overflow (IIM #1#2H)	CU
00CD	WARNING	CAN: FU #1H not addressable	CU
00CE	WARNING	CAN: rx-signal conflict (FU #1H)	CU
00CF	WARNING	CAN: No RTR from FU #1H	CU
00CG	WARNING	CPU: Domain tx response, Mailbox type wrong	CU
00CH	WARNING	CPU: Invalid tbdor-Parameter FU_type	CU
00CI	NOT USED	CAN: No FU acknowledges	CU
00CJ	WARNING	CAN auto configuration successfull (#1H)	CU
00CK	WARNING	CAN auto configuration without success (#1H)	CU
00CL	WARNING	CAN: FU #1H not addressable	CU
00CM	WARNING	CAN: FU #1H sent event and did not answer RTR	CU
00CP	WARNING	CAN: Max FU count exceeded	CU
00CQ	NOT USED	SYSCAN: Radiography system is not responding	CU
00CR	WARNING	SYSCAN: Guarded connection failed	CU
00CX	WARNING	CAN: Last-only-repeat-counter overflow (IIM #1#2H)	CU
00CY	WARNING	CAN: Abort of rx of IIM #1#2H (unexp frame)	CU
00CZ	WARNING	CAN: Unexpected frame received after IIM #1#2H	CU
00DA	WARNING ERROR	No CPU-Access to CAN-chip	CU
00DB	NOT USED	CAN-chip reset not acknowledged	CU
00DC	NOT USED	CAN-chip reset release not acknowledged	CU
00DD	WARNING	CAN-chip DPRAM check failed	CU
00DE	WARNING ERROR	Unexpected CAN-chip int-pointer	CU
00DF	NOT USED	CAN-chip state undefined	CU
00DG	WARNING	CAN-chip error-active after passive #1H	CU
00DH	WARNING	CAN-chip state error-passive #1H	CU
00DI	ERROR	CAN-chip state bus OFF #1H	CU
00DJ	NOT USED	CAN-chip state DPRAM-error	CU
00DK	NOT USED	CAN-chip state DPRAM-error & passive	CU

Error code	Error class	Error text	FU
00DL	NOT USED	Unexpected CAN-chip interrupt	CU
00DM	WARNING	CAN frame error (code #1H)	CU
00E0	ERROR	iRMX exception #2#1H occurred	CU
00G0	WARNING ERROR	Variable in case statement has undefined value	CU
00G1	ERROR	Condition_code <> OK after CALL to send	CU
00G2	WARNING	Condition_code <> OK after CALL to init	CU
00I1	NOT USED	CPU index to I/O-table is wrong	CU
00I2	WARNING	No interrupt reason on sig-bus	CU
00I3	WARNING	No interrupt reason on XS-bus	CU
00I4	ERROR	One FU has a WD-error, scantime_TV is not programmed correctly See: XRGSCOPE --> OPTIMUS --> Program --> Dose rate control --> CONT: scantime_TV = 20.00ms	CU
00L1	ERROR	GC: Checksum error	CU
00L2	ERROR	GC: Data access error	CU
00L3	ERROR	GC: Limit data error	CU
00L4	WARNING ERROR	GC: Limits inconsistent	CU
00L5	ERROR	GC: Calculation error	CU
00L6	ERROR	GC: Function not implemented	CU
00M0	ERROR	Unable to initialise FU(s) #1H, #2H, #3H, #4H, #5H, #6H	CU
00M1	ERROR	Configuration key is missing or defective	CU
00M2	NOT USED	Unable to initialise the FU mA	CU
00M3	ERROR	No response at all from FU(s) #1H, #2H, #3H, #4H, #5H, #6H	CU
00PA	WARNING	CPU: IIM/MSC number unknown	CU
00PB	WARNING	CPU: Technique mode unknown	CU
00PC	WARNING	CPU: Value limit overflow	CU
00PD	ERROR	PC comm: Unknown TDL proc ID	CU
00PE	WARNING	NVRAM: DRC NV checksum error	CU
00PF	WARNING	CPU: Equal kV-sets from CU come twice	CU
00PG	WARNING	CPU: kV sequence does not increase	CU
00PH	WARNING	CPU: EDL is not possible, min_mA limit	CU
00PI	WARNING	CPU: DCALC Dr_curve has only one element	CU
00PJ	WARNING	CPU: DCALC Dr_curve has strange values	CU

Error code	Error class	Error text	FU
00PK	WARNING	CPU: Equal kV-sets from CU with equal mA	CU
00PL	WARNING	CPU: Dose digits disturbance	CU
00S*	SERVICE	PCcomm: Service access trace	CU
00S?	WARNING ERROR	PCcomm: Unexpected error	CU
00S0	ERROR	PCcomm: Tube programming error	CU
00SA	ERROR	PCcomm: Not enough space at destination segment	CU
00SB	NOT USED	PCcomm: Base out of range	CU
00SC	ERROR	PCcomm: Value too large	CU
00SD	ERROR	PCcomm: Terminator not found	CU
00SE	ERROR	PCcomm: Error in description	CU
00SF	ERROR	PCcomm: Item type unknown	CU
00SG	ERROR	PCcomm: Internal type unknown	CU
00SH	ERROR	PCcomm: Value negative	CU
00SI	NOT USED	PCcomm: Not enough space at destination buffer	CU
00SJ	ERROR	PCcomm: Syntax wrong	CU
00SK	ERROR	PCcomm: String too long	CU
00SL	WARNING	PCcomm: String truncated	CU
00SM	WARNING	PCcomm: TDL segment overflow	CU
00SN	ERROR	PCcomm: FU Reference Table full	CU
00SO	ERROR	PCcomm: Node ID unknown	CU
00SP	ERROR	PCcomm: FU Code unknown	CU
00SQ	ERROR	PCcomm: Syntax error in node ID	CU
00SR	WARNING	PCcomm: No node ID found	CU
00SS	ERROR	PCcomm: Request not performed	CU
00ST	ERROR	PCcomm: RMX error	CU
00SU	WARNING	PCcomm: Enumeration element not found	CU
00SV	ERROR	PCcomm: Mail corrupted	CU
00SW	ERROR	PCcomm: Procedure ID unknown	CU
00SX	ERROR	PCcomm: FU mA incompatible	CU
00SY	ERROR	PCcomm: FU Off request failed	CU
00SZ	ERROR	PCcomm: Wrong response	CU
00T?	ERROR	TTS: Unexpected error	CU
00TA	ERROR	TTS: Received message unknown	CU

Error code	Error class	Error text	FU
00TB	ERROR	TTS: Tube supervision error from FU kV. Thermal switch of tube housing okay?	CU
00TC	ERROR	TTS: Internal TTS error	CU
00TD	ERROR	TTS: Tube number unknown	CU
00TE	ERROR	TTS: NVRAM checksum error	CU
00TF	ERROR	TTS: NVRAM unavailable	CU
00TG	ERROR	TTS: Tube overheated	CU
00TH	WARNING	TTS: Load data supply inconsistent	CU
00X0	ERROR	CPU wrong timer ID	CU
00X1	ERROR	CPU wrong timer mode	CU
00X2	ERROR	CPU wrong message type	CU
00X3	WARNING	CPU DWORD does not fit into BYTE3	CU
00X4	WARNING ERROR	Timeout of X-ray backup timer	CU
00X5	WARNING	Timeout of X-ray rotation timer	CU
00X6	WARNING	Timeout setting FUs, response missing	CU
00X7	WARNING	CPU curve token is NO_TOKEN	CU
00XA	NOT USED	NVRAM switch table invalid	CU
00XB	WARNING	NVRAM tube data rotation invalid	CU
00XC	WARNING	NVRAM watch dog invalid	CU
00XD	WARNING	NVRAM configuration table invalid	CU
00XE	WARNING	NVRAM test data invalid	CU
00XF	WARNING	NVRAM RoCo data invalid	CU
00XG	NOT USED	CPU received IIM is unknown	CU
00XH	NOT USED	CPU received FU-type is unknown	CU
00XI	ERROR	Init with FU-RoCo not OK	CU
00XJ	WARNING ERROR	Exposure time too short	CU
00XK	WARNING	CPU FUmA refuses set data	CU
00XL	WARNING	NVRAM tube yield table invalid	CU
00XM	WARNING	NVRAM add filter corr table invalid	CU
00XN	WARNING	NVRAM wedge filter corr table invalid	CU
00XO	ERROR	Exposure time too long	CU
00XP	WARNING	Exposure time too long	CU
00XQ	WARNING	NVRAM tube statistic data invalid	CU

Error code	Error class	Error text	FU
00XR	WARNING	NVRAM gsta data invalid	CU
00XS	WARNING	Tube no. in CU and FUkV different	CU
00XT	WARNING	Rotation in CU and FURoCo FUCIE different	CU
00XU	ERROR	Transition endless loop	CU
00XV	WARNING	NVRAM HW test flags invalid	CU
00XW	ERROR	EN_X active in startup	CU
00XX	ERROR	RD_PR_X stays active after prep	CU
02AB	WARNING	Procedure called with wrong parameter	FU_kV
02AC	ERROR	Wrong index for table access	FU_kV
02AD	ERROR	Wrong do case entry	FU_kV
02AE	WARNING	Unknown IIM received	FU_kV
02AF	WARNING	IIM parameter out of range	FU_kV
02CA	WARNING	Error in CASE selector	FU_kV
02CB	WARNING	A CAN message with wrong IIM-no (no recipient defined) received	FU_kV
02CC	WARNING	Multiple receiption of the same CAN frame (transmitter ill)	FU_kV
02CE	WARNING	Unexpected signal value in CAN rx task	FU_kV
02CF	WARNING	CAN bus timeout while domain transmission	FU_kV
02CG	WARNING	Token of CAN response mailbox is not a mailbox token	FU_kV
02CX	WARNING	Multiple rx of the same CAN last/only frame (transmitter ill)	FU_kV
02CY	WARNING	Aborted CAN domain receive (because of timeout or wrong signal)	FU_kV
02CZ	WARNING	Unexpected CAN domain frame received (outside IIM-reception)	FU_kV
02DA	WARNING	No CPU access to the CAN controller	FU_kV
02DB	WARNING	Reset or release of the CAN controller was not acknowledged	FU_kV
02DD	WARNING	Check of the DPRAM of the CAN controller failed	FU_kV
02DE	WARNING	Unexpected interrupt pointer in the CAN controller	FU_kV
02DF	WARNING	CAN controller state undefined	FU_kV
02DG	WARNING	CAN controller state ERROR ACTIVE after ERROR PASSIVE	FU_kV
02DH	WARNING	CAN controller state ERROR PASSIVE	FU_kV
02DI	WARNING	CAN controller state BUS OFF	FU_kV
02DJ	WARNING	CAN controller state DPRAM ERROR	FU_kV
02DK	WARNING	CAN controller state DPRAM ERROR and ERROR PASSIVE	FU_kV
02EA	ERROR	Interrupt 0: Divide by zero	FU_kV
02EB	ERROR	Interrupt 1: Single step	FU_kV

Error code	Error class	Error text	FU
02EC	ERROR	Interrupt 2: NMI	FU_kV
02ED	ERROR	Interrupt 3: Breakpoint	FU_kV
02EE	ERROR	Interrupt 4: Overflow exception	FU_kV
02EF	ERROR	Interrupt 5: Array bounds exception	FU_kV
02EG	ERROR	Interrupt 6: Unused opcode	FU_kV
02EH	ERROR	Interrupt 7: ESC opcode	FU_kV
02EI	ERROR	CAN connection to CU lost	FU_kV
02GA	WARNING	Interpolation not possible	FU_kV
02HA	WARNING	kV nominal value out of range: ± (4% + 1kV); 3 detections within 30ms	FU_kV
02HB	ERROR	kV nominal value out of range: 0kV > U > 170kV	FU_kV
02HC	WARNING	Z nominal value out of range: ±1% ±0.2; 3 detections within 30ms; duty cycle range 3% ... 30%	FU_kV
02HD	ERROR	Z nominal value out of range: 0% > Z > 50%	FU_kV
02HE	WARNING	kV value during standby too large: > 3kV for > 400ms after PREP	FU_kV
02HF	ERROR	kV value during standby too large: > 4kV for > 400ms after PREP	FU_kV
02HG	WARNING	kV actual value out of range: ±(4% + 1kV); 2 detections within 20ms	FU_kV
02HH	ERROR	kV actual value out of range: 20kV > U > 170kV; 3 detections within 30ms	FU_kV
02HI	WARNING	E value during standby out of range: 470V > E > 780V; 3 detections within 30ms	FU_kV
02HJ	ERROR	E value during standby out of range: 450V > E > 800V; 3 detections within 30ms	FU_kV
02HK	WARNING	E value during high tension out of range: 400V > E > 780V; 3 detections within 30ms	FU_kV
02HL	ERROR	E value during high tension out of range: 350V > E > 800V; 3 detections within 30ms	FU_kV
02HM	WARNING	Converter 1 temperature out of range: 0°C > T > 85°C; 3 detections within 30ms	FU_kV
02HN	ERROR	Converter 1 temperature out of range: 0°C > T > 90°C; 3 detections within 30ms	FU_kV
02HO	WARNING	Converter 2 temperature out of range: 0°C > T > 85°C; 3 detections within 30ms	FU_kV
02HP	ERROR	Converter 2 temperature out of range: 0°C > T > 90°C; 3 detections within 30ms	FU_kV

Error code	Error class	Error text	FU
02HQ	WARNING	High tension tank temperature out of range: 0°C > T > 80°C; 3 detections within 30ms	FU_kV
02HR	ERROR	High tension tank temperature out of range: 0°C > T > 85°C; 3 detections within 30ms	FU_kV
02HS	WARNING	Divider test cathode out of range: 45.5kV > U > 50.5kV; 3 detections within 30ms	FU_kV
02HT	ERROR	Divider test cathode out of range: 43kV $\geq$ U > 53kV; 3 detections within 30ms	FU_kV
02HU	WARNING	Divider test anode out of range: 45.5kV > U > 50.5kV; 3 detections within 30ms	FU_kV
02HV	ERROR	Divider test anode out of range: 43kV $\geq$ U > 53kV; 3 detections within 30ms	FU_kV
02HW	WARNING	kV asymmetrical: ±15%; 2 detections within 20ms	FU_kV
02HX	ERROR	kV asymmetrical: ±15%; 3 detections within 30ms	FU_kV
02MA	ERROR	State request not accepted because of grid mode	FU_kV
02MB	ERROR	State request not accepted because of error state	FU_kV
02MC	WARNING	State requested by CU unknown	FU_kV
02OA	ERROR	RMX error: Timeout	FU_kV
02OB	ERROR	RMX error: Memory	FU_kV
02OC	ERROR	RMX error: Busy	FU_kV
02OE	ERROR	RMX error: Limit	FU_kV
02OF	ERROR	RMX error: Context	FU_kV
02OG	ERROR	RMX error: Exist	FU_kV
02OH	ERROR	RMX error: State	FU_kV
02OI	ERROR	RMX error: Not configured	FU_kV
02OJ	ERROR	RMX error: Interrupt saturation	FU_kV
02OK	ERROR	RMX error: Interrupt overflow	FU_kV
02OL	ERROR	RMX error: Transmission	FU_kV
02OM	ERROR	RMX error: Divide by zero	FU_kV
02ON	ERROR	RMX error: Overflow	FU_kV
02OO	ERROR	RMX error: Type	FU_kV
02OP	ERROR	RMX error: Parameter	FU_kV
02OQ	ERROR	RMX error: Bad call	FU_kV
02OR	ERROR	RMX error: Array bound	FU_kV
02OS	ERROR	RMX error: NDP error	FU_kV

Error code	Error class	Error text	FU
02OT	ERROR	RMX error: Illegal opcode	FU_kV
02OU	ERROR	RMX error: Emulator trap	FU_kV
02OV	ERROR	RMX error: Interrupt table limit	FU_kV
02OW	ERROR	RMX error: CPU xfer data limit	FU_kV
02OX	ERROR	RMX error: Wrap around	FU_kV
02OY	ERROR	RMX error: Check exception	FU_kV
02OZ	ERROR	RMX error: Unknown	FU_kV
02RA	WARNING	Grid mode changeover requested during prep	FU_kV
02RB	WARNING	Tube switch requested during preparation	FU_kV
02RC	WARNING	Requested P out of range	FU_kV
02SA	WARNING	Not enough space at the destination	FU_kV
02SB	WARNING	Base out of range	FU_kV
02SC	WARNING	PC comm.: Value too large	FU_kV
02SD	WARNING	Terminator not found	FU_kV
02SE	WARNING	PC comm.: Error in description	FU_kV
02SF	WARNING	PC comm.: Item type unknown	FU_kV
02SG	WARNING	PC comm.: Internal type unknown	FU_kV
02SH	WARNING	PC comm.: Value negative	FU_kV
02SI	WARNING	PC comm.: No space at dest. buffer	FU_kV
02SJ	WARNING	PC comm.: Syntax wrong	FU_kV
02SK	WARNING	PC comm.: String too long	FU_kV
02SL	WARNING	PC comm.: String truncated	FU_kV
02SO	WARNING	PC comm.: Unknown table ID received	FU_kV
02SP	WARNING	PC comm.: Access level to low	FU_kV
02SQ	WARNING	PC comm.: Unknown action requested	FU_kV
02SR	WARNING	PC comm.: Routing or message corrupt	FU_kV
02SS	WARNING	Source buffer to small for incoming message	FU_kV
02ST	WARNING	CAN buffer to small for outgoing message	FU_kV
02SU	WARNING	PC comm.: Access level is N/A	FU_kV
02UA	ERROR	HW configuration identifier wrong	FU_kV
02UB	WARNING	Set Up request received during preparation	FU_kV
02WA	WARNING	Wrong tube selected	FU_kV
02WB	ERROR	Wrong tube selected	FU_kV

Error code	Error class	Error text	FU
02WC	WARNING	EN X C signal faulty	FU_kV
02WD	ERROR	EN X C signal faulty	FU_kV
02WE	WARNING	Wrong grid mode selected	FU_kV
02WF	ERROR	Wrong grid mode selected	FU_kV
02WG	WARNING	Tube arcing detected	FU_kV
02WH	ERROR	Tube arcing detected	FU_kV
02WI	WARNING	kV over voltage detected	FU_kV
02WJ	ERROR	kV over voltage detected	FU_kV
02WK	WARNING	Measuring not stable	FU_kV
02WL	ERROR	Tube supervision error	FU_kV
02WM	ERROR	Tube supervision error	FU_kV
03AA	WARNING	Internal parameter error	FU_mA_a
03AB	WARNING	Wrong parameter from CU	FU_mA_a
03AC	WARNING	Ie-regulation active on two filaments; only in case of VARIOFOCUS	FU_mA_a
03AI	WARNING	Wrong IIM received	FU_mA_a
03BA	WARNING	Coordinates not monotonous	FU_mA_a
03BB	WARNING	No measurement values for adap. found	FU_mA_a
03CA	WARNING	Error in CASE selector	FU_mA_a
03CB	WARNING	A CAN message with wrong IIM-no (no recipient defined) received	FU_mA_a
03CC	WARNING	Multiple receiption of the same CAN frame (transmitter ill)	FU_mA_a
03CE	WARNING	Unexpected signal value in CAN rx task	FU_mA_a
03CF	WARNING	CAN bus timeout while domain transmission	FU_mA_a
03CG	WARNING	Token of CAN response mailbox is not a mailbox token	FU_mA_a
03CX	WARNING	Multiple rx of the same CAN last/only frame (transmitter ill)	FU_mA_a
03CY	WARNING	Aborted CAN domain receive (because of timeout or wrong signal)	FU_mA_a
03CZ	WARNING	Unexpected CAN domain frame received (outside IIM-reception)	FU_mA_a
03DA	WARNING	No CPU access to the CAN controller	FU_mA_a
03DB	WARNING	Reset or release of the CAN controller was not acknowledged	FU_mA_a
03DD	WARNING	Check of the DPRAM of the CAN controller failed	FU_mA_a
03DE	WARNING	Unexpected interrupt pointer in the CAN controller	FU_mA_a
03DF	WARNING	CAN controller state undefined	FU_mA_a
03DG	WARNING	CAN controller state ERROR ACTIVE after ERROR PASSIVE	FU_mA_a
03DH	WARNING	CAN controller state ERROR PASSIVE	FU_mA_a

Error code	Error class	Error text	FU
03DI	WARNING	CAN controller state BUS OFF	FU_mA_a
03DJ	WARNING	CAN controller state DPRAM ERROR	FU_mA_a
03DK	WARNING	CAN controller state DPRAM ERROR and ERROR PASSIVE	FU_mA_a
03EA	ERROR	CPU interrupt 0	FU_mA_a
03EB	ERROR	CPU interrupt 1	FU_mA_a
03ED	ERROR	CPU interrupt 3	FU_mA_a
03EE	ERROR	CPU interrupt 4	FU_mA_a
03EF	ERROR	CPU interrupt 5	FU_mA_a
03EG	ERROR	CPU interrupt 6	FU_mA_a
03EH	ERROR	CPU interrupt 7	FU_mA_a
03EI	ERROR	CAN is unable to send an error to CU	FU_mA_a
03FA	WARNING	NVRAM: Invalid checksum	FU_mA_a
03FB	WARNING	NVRAM: Standby filament not found	FU_mA_a
03FC	ERROR	No NVRAM plugged in	FU_mA_a
03FD	WARNING	NVRAM empty; battery?	FU_mA_a
03GA	ERROR	Limit error	FU_mA_a
03GB	WARNING	Real math. error: Real underflow	FU_mA_a
03GC	WARNING	Real math. error: Real overflow	FU_mA_a
03GD	WARNING	Real math. error: Dword overflow	FU_mA_a
03GE	WARNING	Real math. error: Integer overflow	FU_mA_a
03GF	WARNING	Real math. error: Word overflow	FU_mA_a
03GG	WARNING	Singular matrix	FU_mA_a
03HA	ERROR	Unknown hardware	FU_mA_a
03HB	WARNING ERROR	Intermediate circuit voltage < 200V	FU_mA_a
03HF	WARNING	Undefined analog input channel	FU_mA_a
03HG	WARNING	If-actual out of tolerance	FU_mA_a
03HH	ERROR	If setpoint to large	FU_mA_a
03HI	ERROR	If-actual out of tolerance	FU_mA_a
03HJ	ERROR	If-actual out of tolerance	FU_mA_a
03HK	WARNING	If-nominal out of tolerance	FU_mA_a
03HL	ERROR	If-nominal out of tolerance	FU_mA_a
03HM	ERROR	If-nominal out of tolerance	FU_mA_a
03HN	ERROR	No retrigger received from CU	FU_mA_a

Error code	Error class	Error text	FU
03IA	WARNING	Adaptation cannot be completed	FU_mA_a
03IC	WARNING	No Ie-adaptation measurement values	FU_mA_a
03ID	WARNING	Ie-adaptation values not evaluable	FU_mA_a
03KA	WARNING	Condi.-X-Ray mode without mAs parameter	FU_mA_a
03MA	WARNING	Undefined status	FU_mA_a
03MB	WARNING	Status change not allowed	FU_mA_a
03MC	WARNING	FU init data not expected	FU_mA_a
03OA	ERROR	RMX exception: E$TIME	FU_mA_a
03OB	ERROR	RMX exception: E$MEM	FU_mA_a
03OC	ERROR	RMX exception: E$BUSY	FU_mA_a
03OD	ERROR	RMX exception: E$LIMIT	FU_mA_a
03OE	ERROR	RMX exception: E$CONTEXT	FU_mA_a
03OF	ERROR	RMX exception: E$EXIST	FU_mA_a
03OG	ERROR	RMX exception: E$STATE	FU_mA_a
03OH	ERROR	RMX exception: ENOTCONFIGURED	FU_mA_a
03OI	ERROR	RMX exception: E$INTERRUPT$SATURATION	FU_mA_a
03OJ	ERROR	RMX exception: E$INTERRUPT$OVERFLOW	FU_mA_a
03OK	ERROR	RMX exception: E$TRANSMISSION	FU_mA_a
03OL	ERROR	RMX exception: E$ZERO$DIVIDE	FU_mA_a
03OM	ERROR	RMX exception: E$OVERFLOW	FU_mA_a
03ON	ERROR	RMX exception: E$TYPE	FU_mA_a
03OO	ERROR	RMX exception: E$PARAM	FU_mA_a
03OP	ERROR	RMX exception: EBADCALL	FU_mA_a
03OQ	ERROR	RMX exception: E$ARRAY$BOUND	FU_mA_a
03OR	ERROR	RMX exception: ENDPERROR	FU_mA_a
03OS	ERROR	RMX exception: E$ILLEGAL$OPCODE	FU_mA_a
03OT	ERROR	RMX exception: E$EMULATOR$TRAP	FU_mA_a
03OU	ERROR	RMX exception: E$INTERRUPT$TABLE$LIMIT	FU_mA_a
03OV	ERROR	RMX exception: E$CPUXFER$DATA$LIMIT	FU_mA_a
03OW	ERROR	RMX exception: ESEGWRAP$AROUND	FU_mA_a
03OX	ERROR	RMX exception: E$CHECK$EXCEPTION	FU_mA_a
03OY	ERROR	Unknown RMX exception	FU_mA_a
03PA	ERROR	Ie zero measured	FU_mA_a

Error code	Error class	Error text	FU
03PB	WARNING	Ie out of tolerance: $\pm$10% (Ie > 5mA, exp. time $\leq$ 44ms) or $\pm$3% (Ie > 5mA, exp. time > 44ms)	FU_mA_a
03PC	ERROR	Ie out of tolerance: $\pm$30% (Ie > 5mA, exp. time > 44ms)	FU_mA_a
03PD	WARNING	Setpoint for Ie-regulation incorrect	FU_mA_a
03PE	ERROR	Emergency OFF! Grid not closed!	FU_mA_a
03PF	ERROR	No kV discharged due to missing Ie	FU_mA_a
03SC	WARNING	PC comm.: Value too large	FU_mA_a
03SE	WARNING	PC comm.: Error in description	FU_mA_a
03SF	WARNING	PC comm.: Item type unknown	FU_mA_a
03SG	WARNING	PC comm.: Internal type unknown	FU_mA_a
03SH	WARNING	PC comm.: Value negative	FU_mA_a
03SI	WARNING	PC comm.: No space at dest. buffer	FU_mA_a
03SJ	WARNING	PC comm.: Syntax wrong	FU_mA_a
03SK	WARNING	PC comm.: String too long	FU_mA_a
03SL	WARNING	PC comm.: String truncated	FU_mA_a
03SO	WARNING	PC comm.: Unknown table ID received	FU_mA_a
03SP	WARNING	PC comm.: Access level to low	FU_mA_a
03SQ	WARNING	PC comm.: Unknown action requested	FU_mA_a
03SR	WARNING	PC comm.: Routing or message corrupt	FU_mA_a
03SU	WARNING	PC comm.: Access level is N/A	FU_mA_a
07CA	ERROR	CAN: Case-selector error	FU_CIE
07CB	WARNING	CAN: Invalid CAN ID %u	FU_CIE
07CC	ERROR	CAN: Frame rep. overflow IIM%u	FU_CIE
07CD	ERROR	CAN: No RTR from CU	FU_CIE
07CE	ERROR	CAN: rx signal conflict IIM%u	FU_CIE
07CF	ERROR	CAN: tx timeout	FU_CIE
07CI	WARNING	CAN: IMPOSSIBLE ERROR	FU_CIE
07CP	WARNING	CAN: CPU: PXerr %d %s(%d)	FU_CIE
07CR	WARNING	CAN: CPU: Message request fail	FU_CIE
07CS	WARNING	CAN: CPU: Message send error	FU_CIE
07CY	ERROR	CAN: rx abort IIM%u	FU_CIE
07CZ	WARNING	CAN: Unexpected frame (IIM%u)	FU_CIE
07DA	ERROR	CAN: Chip access error	FU_CIE

Error code	Error class	Error text	FU
07DB	ERROR	CAN: Chip reset error	FU_CIE
07DC	ERROR	CAN: Chip reset release error	FU_CIE
07DE	WARNING	CAN: Illegal interrupt pointer	FU_CIE
07DF	ERROR	CAN: Chip state undefined	FU_CIE
07DG	WARNING	CAN: Chip err act. after pass.	FU_CIE
07DH	WARNING	CAN: Chip state error passive	FU_CIE
07DI	WARNING	CAN: Chip state bus OFF	FU_CIE
07DJ	ERROR	CAN: Chip DPRAM error	FU_CIE
07DK	WARNING	CAN: Chip DPRAM error & passive	FU_CIE
07DL	WARNING	CAN: Unexpected interrupt	FU_CIE
07LA	WARNING	CV received IIM unknown	FU_CIE
07LB	WARNING	RC stator number out of range	FU_CIE
07LC	WARNING	RC stator not available	FU_CIE
07LD	ERROR	RC stator 1 readback failed	FU_CIE
07LE	ERROR	RC stator 2 readback failed	FU_CIE
07LF	ERROR	RC stator 3 readback failed	FU_CIE
07LG	WARNING	RC speed value out of range	FU_CIE
07LH	ERROR	RC speed set timeout	FU_CIE
07LI	WARNING	RC maximal stator load exceeded	FU_CIE
07LJ	ERROR	RC maximal rotation time exceeded	FU_CIE
07LK	WARNING	AM amplimat chamber number out of range	FU_CIE
07LL	WARNING	AM amplimat field number out of range	FU_CIE
07LM	WARNING	AM amplimat delay value out of range	FU_CIE
08CA	ERROR	CAN: Case-selector error	FU_HI_a
08CB	WARNING	CAN: Invalid CAN ID %u	FU_HI_a
08CC	ERROR	CAN: Frame rep. overflow IIM%u	FU_HI_a
08CD	ERROR	CAN: No RTR from CU	FU_HI_a
08CE	ERROR	CAN: rx signal conflict IIM%u	FU_HI_a
08CF	ERROR	CAN: tx timeout	FU_HI_a
08CI	WARNING	CAN: IMPOSSIBLE ERROR	FU_HI_a
08CP	WARNING	CAN: CPU: PXerr %d %s(%d)	FU_HI_a
08CR	WARNING	CAN: CPU: message request fail	FU_HI_a
08CS	WARNING	CAN: CPU: message send error	FU_HI_a

Error code	Error class	Error text	FU
08CY	ERROR	CAN: rx abort IIM%u	FU_HI_a
08CZ	WARNING	CAN: Unexpected frame (IIM%u)	FU_HI_a
08DA	ERROR	CAN: Chip access error	FU_HI_a
08DB	ERROR	CAN: Chip reset error	FU_HI_a
08DC	ERROR	CAN: Chip reset release error	FU_HI_a
08DE	WARNING	CAN: Illegal interrupt pointer	FU_HI_a
08DF	ERROR	CAN: Chip state undefined	FU_HI_a
08DG	WARNING	CAN: Chip err act. after pass.	FU_HI_a
08DH	WARNING	CAN: Chip state error passive	FU_HI_a
08DI	WARNING	CAN: Chip state bus OFF	FU_HI_a
08DJ	ERROR	CAN: Chip DPRAM error	FU_HI_a
08DK	WARNING	CAN: Chip DPRAM error & passive	FU_HI_a
08DL	WARNING	CAN: Unexpected interrupt	FU_HI_a
08HA	ERROR	No message receive displaytask	FU_HI_a
08HB	ERROR	No message release displaytask	FU_HI_a
08HC	ERROR	APR not found	FU_HI_a
08HD	ERROR	Offset in menu structure out of range	FU_HI_a
08HF	ERROR	No message request for test task	FU_HI_a
08HG	ERROR	No message send for test task	FU_HI_a
08HH	ERROR	APR buffer full	FU_HI_a
08HI	ERROR	No message send for test task	FU_HI_a
08HJ	ERROR	No send message to CU from ODD	FU_HI_a
08HK	ERROR	Data error in CAN message	FU_HI_a
08HL	ERROR	No message send for service task	FU_HI_a
08IE	ERROR	Wrong setup IIM	FU_HI_a
08SA	ERROR	No request domtxtask when scanning	FU_HI_a
08SB	ERROR	No request domtxtask when testing	FU_HI_a
08SC	ERROR	No send message to task2_sc	FU_HI_a
10CA	ERROR	CAN: Case-selector error	FU_RC_a
10CB	WARNING	CAN: Invalid CAN ID %u	FU_RC_a
10CC	ERROR	CAN: Frame rep. overflow IIM%u	FU_RC_a
10CD	ERROR	CAN: No RTR from CU	FU_RC_a
10CE	ERROR	CAN: rx signal conflict IIM%u	FU_RC_a

Error code	Error class	Error text	FU
10CF	ERROR	CAN: tx timeout	FU_RC_a
10CI	WARNING	CAN: IMPOSSIBLE ERROR	FU_RC_a
10CP	WARNING	CAN: CPU: PXerr %d %s(%d)	FU_RC_a
10CR	WARNING	CAN: CPU: Message request fail	FU_RC_a
10CS	WARNING	CAN: CPU: Message send error	FU_RC_a
10CY	ERROR	CAN: rx abort IIM%u	FU_RC_a
10CZ	WARNING	CAN: Unexpected frame (IIM%u)	FU_RC_a
10DA	ERROR	CAN: Chip access error	FU_RC_a
10DB	ERROR	CAN: Chip reset error	FU_RC_a
10DC	ERROR	CAN: Chip reset release error	FU_RC_a
10DE	WARNING	CAN: Illegal interrupt pointer	FU_RC_a
10DF	ERROR	CAN: Chip state undefined	FU_RC_a
10DG	WARNING	CAN: Chip err act. after pass.	FU_RC_a
10DH	WARNING	CAN: Chip state error passive	FU_RC_a
10DI	WARNING	CAN: Chip state bus OFF	FU_RC_a
10DJ	ERROR	CAN: Chip DPRAM error	FU_RC_a
10DK	WARNING	CAN: Chip DPRAM error & passive	FU_RC_a
10DL	WARNING	CAN: Unexpected interrupt	FU_RC_a
10FB	ERROR	Short circuit detected	FU_RC_a
10FT	WARNING	Overcurrent detected	FU_RC_a
10IF	WARNING	Initialization failed	FU_RC_a
10LA	WARNING	Acceleration count limit exceeded	FU_RC_a
10LH	ERROR	Phase current %u mA (>%u)	FU_RC_a
10LL	ERROR	Phase current %u mA (<%u)	FU_RC_a
10LO	WARNING ERROR	Intermediate voltage %u V (>%u)	FU_RC_a
10LT	ERROR	Temperature limit exceeded	FU_RC_a
10LU	WARNING ERROR	Intermediate voltage %u V (<%u)	FU_RC_a
10LZ	ERROR	Temperature sensor failure	FU_RC_a
10OE	WARNING	CPU: PXROS error %d	FU_RC_a
10OF	WARNING	CPU: PXROS error %d %s(%d)	FU_RC_a
10RC	ERROR	Rotation check failed	FU_RC_a
10RI	ERROR	Invalid rotation request : %u	FU_RC_a

Error code	Error class	Error text	FU
10RT	ERROR	Rotation request timeout	FU_RC_a
10TD	ERROR	Invalid data for tube %u	FU_RC_a
10TE	ERROR	Stator %u hardware error	FU_RC_a
10TF	ERROR	Stator %u switching failed	FU_RC_a
10TI	ERROR	Invalid stator request : %u	FU_RC_a
10TR	ERROR	Stator change with rotating anode	FU_RC_a
10UI	WARNING	Unknown message from CU: IIM %u	FU_RC_a
10UM	WARNING	Unexpected message from CU: IIM %u	FU_RC_a
10WT	WARNING	CPU: Watchdog timeout	FU_RC_a
10XX	WARNING	IMPOSSIBLE ERROR	FU_RC_a
13CA	ERROR	CAN: Case-selector error	FU_AD_a
13CB	WARNING	CAN: Invalid CAN ID %u	FU_AD_a
13CC	ERROR	CAN: Frame rep. overflow IIM%u	FU_AD_a
13CD	ERROR	CAN: No RTR from CU	FU_AD_a
13CE	ERROR	CAN: rx signal conflict IIM%u	FU_AD_a
13CF	ERROR	CAN: tx timeout	FU_AD_a
13CI	WARNING	CAN: IMPOSSIBLE ERROR	FU_AD_a
13CP	WARNING	CAN: CPU: PXerr %d %s(%d)	FU_AD_a
13CR	WARNING	CAN: CPU: Message request fail	FU_AD_a
13CS	WARNING	CAN: CPU: Message send error	FU_AD_a
13CY	ERROR	CAN: rx abort IIM%u	FU_AD_a
13CZ	WARNING	CAN: Unexpected frame (IIM%u)	FU_AD_a
13DA	ERROR	CAN: Chip access error	FU_AD_a
13DB	ERROR	CAN: Chip reset error	FU_AD_a
13DC	ERROR	CAN: Chip reset release error	FU_AD_a
13DE	WARNING	CAN: Illegal interrupt pointer	FU_AD_a
13DF	ERROR	CAN: Chip state undefined	FU_AD_a
13DG	WARNING	CAN: Chip err act. after pass.	FU_AD_a
13DH	WARNING	CAN: Chip state error passive	FU_AD_a
13DI	WARNING	CAN: Chip state bus OFF	FU_AD_a
13DJ	ERROR	CAN: Chip DPRAM error	FU_AD_a
13DK	WARNING	CAN: Chip DPRAM error & passive	FU_AD_a
13DL	WARNING	CAN: Unexpected interrupt	FU_AD_a

Error code	Error class	Error text	FU
13LA	WARNING	CV received IIM unknown	FU_AD_a
13LB	WARNING	IO wrong bidirectional lines output value	FU_AD_a
13LC	WARNING	TR TOMO value for K5 – K12 out of range	FU_AD_a
13LD	WARNING	TR RGDV value out of range	FU_AD_a
13LE	ERROR	TR RGDV readback failed	FU_AD_a
13LF	WARNING	TR wrong sync contact value	FU_AD_a
13LG	WARNING	TR wrong handswitch enable value	FU_AD_a
13LH	ERROR	PR S1/S2 switch active during startup	FU_AD_a
14CA	ERROR	CAN: Case-selector error	FU_AD_b
14CB	WARNING	CAN: Invalid CAN ID %u	FU_AD_b
14CC	ERROR	CAN: Frame rep. overflow IIM%u	FU_AD_b
14CD	ERROR	CAN: No RTR from CU	FU_AD_b
14CE	ERROR	CAN: rx signal conflict IIM%u	FU_AD_b
14CF	ERROR	CAN: tx timeout	FU_AD_b
14CI	WARNING	CAN: IMPOSSIBLE ERROR	FU_AD_b
14CP	WARNING	CAN: CPU: PXerr %d %s(%d)	FU_AD_b
14CR	WARNING	CAN: CPU: Message request fail	FU_AD_b
14CS	WARNING	CAN: CPU: Message send error	FU_AD_b
14CY	ERROR	CAN: rx abort IIM%u	FU_AD_b
14CZ	WARNING	CAN: Unexpected frame (IIM%u)	FU_AD_b
14DA	ERROR	CAN: Chip access error	FU_AD_b
14DB	ERROR	CAN: Chip reset error	FU_AD_b
14DC	ERROR	CAN: Chip reset release error	FU_AD_b
14DE	WARNING	CAN: Illegal interrupt pointer	FU_AD_b
14DF	ERROR	CAN: Chip state undefined	FU_AD_b
14DG	WARNING	CAN: Chip err act. after pass.	FU_AD_b
14DH	WARNING	CAN: Chip state error passive	FU_AD_b
14DI	WARNING	CAN: Chip state bus OFF	FU_AD_b
14DJ	ERROR	CAN: Chip DPRAM error	FU_AD_b
14DK	WARNING	CAN: Chip DPRAM error & passive	FU_AD_b
14DL	WARNING	CAN: Unexpected interrupt	FU_AD_b
14LA	WARNING	CV received IIM unknown	FU_AD_b
14LB	WARNING	IO wrong bidirectional lines output value	FU_AD_b

Error code	Error class	Error text	FU
14LC	WARNING	TR TOMO value for K5 – K12 out of range	FU_AD_b
14LD	WARNING	TR RGDV value out of range	FU_AD_b
14LE	ERROR	TR RGDV readback failed	FU_AD_b
14LF	WARNING	TR wrong sync contact value	FU_AD_b
14LG	WARNING	TR wrong handswitch enable value	FU_AD_b
14LH	ERROR	PR S1/S2 switch active during startup	FU_AD_b
15CA	ERROR	CAN: Case-selector error	FU_AD_c
15CB	WARNING	CAN: Invalid CAN ID %u	FU_AD_c
15CC	ERROR	CAN: Frame rep. overflow IIM%u	FU_AD_c
15CD	ERROR	CAN: No RTR from CU	FU_AD_c
15CE	ERROR	CAN: rx signal conflict IIM%u	FU_AD_c
15CF	ERROR	CAN: tx timeout	FU_AD_c
15CI	WARNING	CAN: IMPOSSIBLE ERROR	FU_AD_c
15CP	WARNING	CAN: CPU: PXerr %d %s(%d)	FU_AD_c
15CR	WARNING	CAN: CPU: Message request fail	FU_AD_c
15CS	WARNING	CAN: CPU: Message send error	FU_AD_c
15CY	ERROR	CAN: rx abort IIM%u	FU_AD_c
15CZ	WARNING	CAN: Unexpected frame (IIM%u)	FU_AD_c
15DA	ERROR	CAN: Chip access error	FU_AD_c
15DB	ERROR	CAN: Chip reset error	FU_AD_c
15DC	ERROR	CAN: Chip reset release error	FU_AD_c
15DE	WARNING	CAN: Illegal interrupt pointer	FU_AD_c
15DF	ERROR	CAN: Chip state undefined	FU_AD_c
15DG	WARNING	CAN: Chip err act. after pass.	FU_AD_c
15DH	WARNING	CAN: Chip state error passive	FU_AD_c
15DI	WARNING	CAN: Chip state bus OFF	FU_AD_c
15DJ	ERROR	CAN: Chip DPRAM error	FU_AD_c
15DK	WARNING	CAN: Chip DPRAM error & passive	FU_AD_c
15DL	WARNING	CAN: Unexpected interrupt	FU_AD_c
15LA	WARNING	CV received IIM unknown	FU_AD_c
15LB	WARNING	IO wrong bidirectional lines output value	FU_AD_c
15LC	WARNING	TR TOMO value for K5 – K12 out of range	FU_AD_c
15LD	WARNING	TR RGDV value out of range	FU_AD_c

Error code	Error class	Error text	FU
15LE	ERROR	TR RGDV readback failed	FU_AD_c
15LF	WARNING	TR wrong sync contact value	FU_AD_c
15LG	WARNING	TR wrong handswitch enable value	FU_AD_c
15LH	ERROR	PR S1/S2 switch active during startup	FU_AD_c
16CA	ERROR	CAN: Case-selector error	FU_AD_d
16CB	WARNING	CAN: Invalid CAN ID %u	FU_AD_d
16CC	ERROR	CAN: Frame rep. overflow IIM%u	FU_AD_d
16CD	ERROR	CAN: No RTR from CU	FU_AD_d
16CE	ERROR	CAN: rx signal conflict IIM%u	FU_AD_d
16CF	ERROR	CAN: tx timeout	FU_AD_d
16CI	WARNING	CAN: IMPOSSIBLE ERROR	FU_AD_d
16CP	WARNING	CAN: CPU: PXerr %d %s(%d)	FU_AD_d
16CR	WARNING	CAN: CPU: Message request fail	FU_AD_d
16CS	WARNING	CAN: CPU: Message send error	FU_AD_d
16CY	ERROR	CAN: rx abort IIM%u	FU_AD_d
16CZ	WARNING	CAN: Unexpected frame (IIM%u)	FU_AD_d
16DA	ERROR	CAN: Chip access error	FU_AD_d
16DB	ERROR	CAN: Chip reset error	FU_AD_d
16DC	ERROR	CAN: Chip reset release error	FU_AD_d
16DE	WARNING	CAN: Illegal interrupt pointer	FU_AD_d
16DF	ERROR	CAN: Chip state undefined	FU_AD_d
16DG	WARNING	CAN: Chip err actin after passive	FU_AD_d
16DH	WARNING	CAN: Chip state error passive	FU_AD_d
16DI	WARNING	CAN: Chip state bus OFF	FU_AD_d
16DJ	ERROR	CAN: Chip DPRAM error	FU_AD_d
16DK	WARNING	CAN: Chip DPRAM error & passive	FU_AD_d
16DL	WARNING	CAN: Unexpected interrupt	FU_AD_d
16LA	WARNING	CV received IIM unknown	FU_AD_d
16LB	WARNING	IO wrong bidirectional lines output value	FU_AD_d
16LC	WARNING	TR TOMO value for K5 - K12 out of range	FU_AD_d
16LD	WARNING	TR RGDV value out of range	FU_AD_d
16LE	ERROR	TR RGDV readback failed	FU_AD_d
16LF	WARNING	TR wrong sync contact value	FU_AD_d

Error code	Error class	Error text	FU
16LG	WARNING	TR wrong handswitch enable value	FU_AD_d
16LH	ERROR	PR S1/S2 switch active during startup	FU_AD_d

7.3. Elimination of error numbers

00PL:

The message 00PL (error of the AEC signal) may be a ”warning” or an “error”. It depends on the disturbance of the AEC signal.
The AEC signal can be measured at pin EZ150 X4 (signal) to EZ150 X3 (see also Z1 ” Basic interface ”).

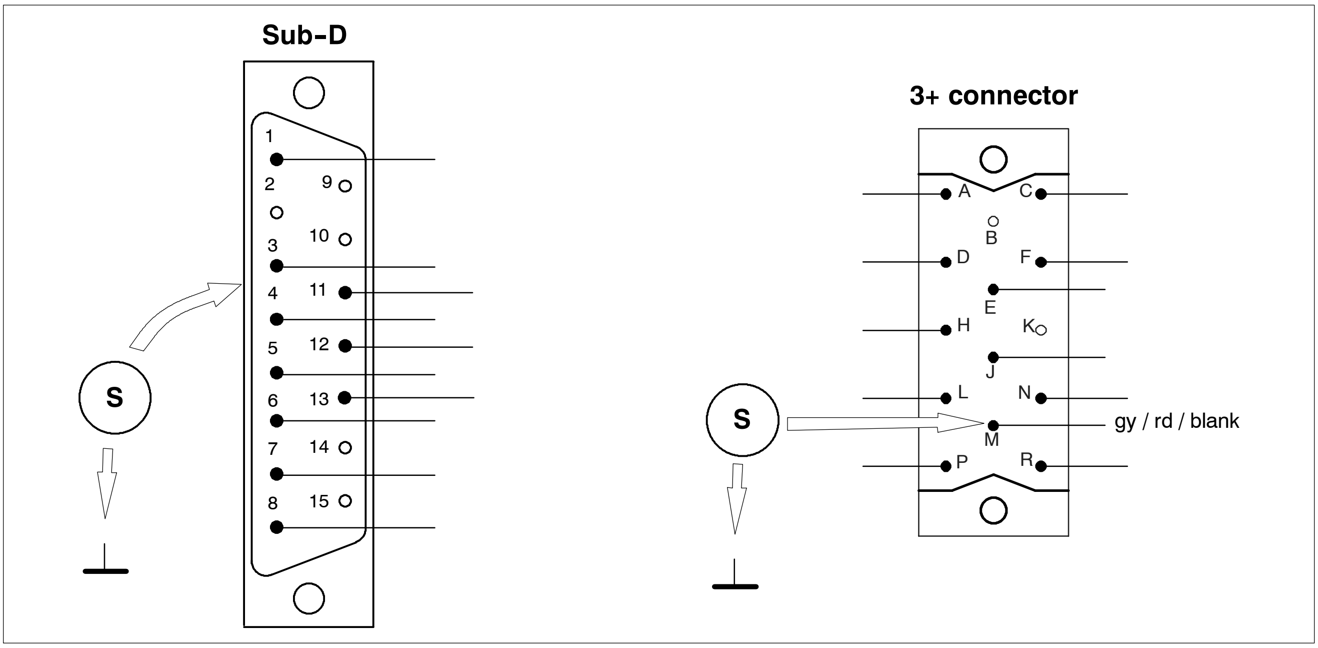
When using measuring chambers there are three possibilities to get the error “00PL”:

1. The shielding of the measuring chamber has a connection to system ground at the measuring chamber or interconnection.
2. In the cable to the measuring chamber is a missing ground connection.
   (This mistake is not possible with the ACL chamber type No. 9890 000 016xx).
3. The measuring chamber is defective.

Localization and elimination of the error source:

Re 1.)

- Remove the connector of the measuring chamber at the generator side.
- Measure connection:
  - **shielding** (Sub-D connector, 15 pins) to **system ground**
    or
  - pin **M** (3+ connector, 14 pins) to system ground ===> **The connection must not be present!**
- Measure connection:
  - **shielding** (Sub-D connector, 15 pins) to **chamber shielding**
    or
  - pin **M** (3+ connector, 14 pins) to chamber shielding ===> **The connection must be present!**

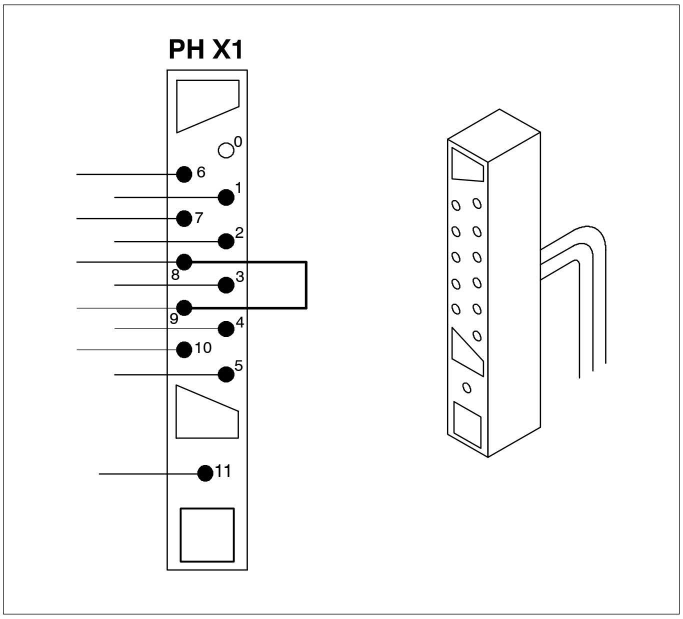


Re 2.)

The connector of the measuring chamber at the generator side has been removed.

- Measure the connection between pin **8** and pin **13** (Sub-D connector).
  The connection must be present!

- If the connection is not present, insert a link between pin **8** and **9** at the chamber connector at the chamber end as shown in the figure.
  In this case the system is most probably operated with an old hybrid measuring chamber 9803 509 xxxxx instead of an ACL measuring chamber 9890 000 016xx. In hybrid measuring chambers the connection between pin **8** <-> **9** is missing.



In case a 3+ connector is used, the connection pin **N** <-> **J** is most probably missing because this connection is not present in hybrid measuring chambers.

To increase interference protection establish the above mentioned connection at the chamber connector of the chamber cable pin **8** <-> **9** in addition to the connection in the adapter for the AMPLIMAT cable (see Z1 “Basic interface”).

Re 3.):

Use a test chamber and compare the function.

8. Power supply

Warning!
During fault finding within the power supply unit be very careful the unit is still connected to the mains.

Switch ON not possible:

- ENF1 not switched ON (visual check)
- ENF1 released
  • check for damage before reactivating ENF1/2 (visual check, any smell?)
- ENF2 not switched ON (visual check)
- ENF2 released by low-voltage supply, filament circuit, tube extension, external components supply
  • check for damage before reactivating ENF1/2 (visual check, any smell?)
- ON circuit EN100 defective

Phase supervision:

1. Without mains adaptation transformer

   - Phase L1 is missing: Mains contactors ENK2 and ENK1 cannot be activated.
   - Phase L2 is missing: The generator can be switched ON but does not go into the READY state.
     The filament-circuit supply is missing.
     There is an error message from function unit kV.
   - Phase L3 is missing: ON circuit without supply voltage.

   - Fault tracing:
     Check leads and fuses up to the mains supply.

2. With mains adaptation transformer

   - In case at least one phase at the primary end is missing, the generator cannot be switched ON. If there is a problem concerning the leads at the secondary end, refer to section 1 “INTRODUCTION AND TECHNICAL DATA”.

After switch-ON or attempted switch-ON:

The generator cannot be brought into the READY state (e.g. no desk display).

- Check the low-voltage supply.
- Check for released ENF1:
  Ground fault / short-circuit of one / several phase(s).
  Check ENK2 and, if necessary, the contacts of ENK1.
  Check the leads and the mains adaptation transformer.
  Check visually whether the contacts of ENK2 or ENK1 have dropped out.
- Check for missed voltage of intermediate-circuit:
  The damping resistors are unsoldered which was caused by overcurrent during switch ON.
  Cause: Short-circuit in the converter, defective charging capacitors, mains-filter capacitors or rectifiers.
  Unsoldering happens about 45s after switch ON.

The damping resistors are unsoldered because the converter was active and ENK1 was not switched ON although activated by the software.
Probably termination of exposure.

This procedure can only happen once because the generator cannot go into STANDBY mode when intermediate-circuit voltage E is missing.

In case intermediate-circuit voltage E is present, ENK1 is activated by the software of the kV-control and remains activated for the complete time the unit is in operation.

In case of high impedance or the tolerance of the symmetry resistors of the intermediate-circuit capacitor battery is too large, capacitors may be destroyed by overvoltage. In case ENK1 has already been activated, ENF1 probably releases.

ENF3 is released by the rotor control units.

The release of ENF2 switches the generator OFF because the supply voltage for the ON circuit and, consequently, the supply voltage of contactors ENK2 and ENK1 is interrupted.

A converter test kit OPTIMUS is available to determine possible problems with the converter, the HT transformer or the tube.
Order no.: 4512 104 9168x

9. Functional description of function unit mA

Tube data must be loaded as a data set from floppy disk via PC and central unit CU into function unit mA.

The procedures described below cannot be carried out before the complete data set for the tube housing assembly is present in central unit CU.

Before the tube adaptation can be started, tube conditioning must be implemented as described in section 2, chapter 8.3.1.

Before adaptation is started, the mA offset value of the mA measuring circuit has to be determined.

This offset value consists of two components:

1. A current of 4mA is impressed upon the mA measuring circuit which is used for continuous calibration (during STANDBY about once per minute).
2. Additionally the kV measuring circuit delivers an offset current depending on the kV.

To measure this total value an exposure is released with 40kV and 500mA filament current. The emission current measured is the correction value for all standard exposures (4mA, measuring circuit current depending on the kV).

As opposed to the standby filament current value of the predecessor versions of generators, the standby filament current value of the Optimus generator is not fixed.

It is determined for each focus individually. A 40kV exposure is released with the focus to be measured while all other foci are switched OFF.

The filament current changes until an emission current of 100μA is obtained.

The associated filament current value is the individual standby filament current (1% to be substracted so that the fluoroscopic current of any of the other foci is not affected).

The following adaptation program takes place fully automatically.

Based on 120 single exposures for each focus a data field is created in the CMOS of function unit mA. The adjustments for all other exposures are interpolated from this data field during operation.

During the adaptation procedure all limit values such as maximum filament current, maximum kV, maximum tube load, maximum output, current of the generator etc. are taken into account.

Boost adaptation

Boost time determination: Positive boosting

With the predecessor versions of generators, a calculated boost current was added to the exposure filament current for a fixed time of 400ms.

With Optimus generators the boost current is always fixed but with a variable time.

The amount of the boost current is the sum of the maximum filament current (of the respective filament) plus 2000mA.

To determine the time values an exposure must be started at a kV stage from which on the filament current does not have to be increased anymore to obtain the max. kV dependent emission current.

As soon as the 100% kV value is reached, the filament current jumps from the STANDBY value to the maximum filament current plus 2000mA. The emission current is measured every 2ms until the maximum tube current or the maximum possible tube current is reached.

In case this procedure takes too long (warming up of the tube), the measurement is continued with a second exposure after a sufficient period of time has passed.

The measurement starts again at the value obtained last.

Boost time determination: Negative boosting

An innovation of the Optimus generator is the determination of the negative boosting (blanking of the filament current).

The measurement is started at the same kV stage as for the positive boost time but with maximum filament current.

As soon as the 100% kV value is reached, the maximum filament current of the filament jumps down to 500mA.

Every 2ms the emission current is measured until a value of 100μA is obtained.

The values for the blanking times are required for techniques such as, for instance, cine.

A filament current value of 500mA must not be exceeded for otherwise the output to supply a gridswitch box (which might be present) is too low.

The following procedure takes place after the generator has been switched ON:

Function unit mA initializes itself and afterwards establishes connection with central unit CU via CAN.

For 3s every focus is boosted with the respective specified maximum filament current. Then blanking of the filament current (500mA) takes place for a variable period of time (derived from negative boost adaptation) to bring the filament current to the STANDBY value (large focus first followed by a smaller one).

The change of the filament current value upon a change of the focus which was the usual routine for the predecessor versions of the Optimus generator does no longer take place. All STANDBY values remain constant.

During operation the following procedure takes place after the release of PREPARATION:

The filament current rises from the individual STANDBY filament current to the boost current.

The switch-ON time of the boost current depends on the difference between STANDBY and the exposure (single boost) or intermediate filament (double boost) current.

Double boost

- The intermediate filament current is a calculated value. It is calculated in such a way that the filament current and thus the filament temperature is brought to exposure level when the boost current is switched ON for another 50ms by the exposure command.
- During exposure the filament current regulates as required.
- At the end of exposure the filament current is reduced to the minimum value of 500mA (negative boosting) for a calculated time to bring it from the exposure to the STANDBY value.
- In case PREPARATION is released, negative boosting takes place until heating can go on with the STANDBY filament current.

10. CAN bus

All the intelligent assemblies and PCBs communicate via the CAN bus. There they are connected in parallel to the two lines CAN_L (low) and CAN_H (high).

The data are serially transmitted in the form of so-called frames.

Levels in quiescent status against chassis:

CAN_L: 2.5V

CAN_H: 2.5V

Levels during data transmission against chassis:

CAN_L: 0.50 ... 2.25V — Both levels are opposite.

CAN_H: 2.75 ... 4.50V — The difference must be > 1.5V!

Test points generator CAN		Test points system CAN	
CAN_L:	EZX71	S_CAN_L:	EZX42:2
CAN_H	EZX72	S_CAN_H:	EZX42:7
Chassis:	EZX5	Chassis:	EZX42:3

Reference: Z1-5.1, Z2-5.1/5.2

Symptoms of errors:

- The generator is inoperable.
- The red LEDs of one or more of the assemblies or PCBs flash.
- Parameter settings at the control desk are accepted and displayed with a considerable delay.
- In the error memory are several entries which code begins with 00C (apart from 00CJ) or the error description contains a reference to signal conflicts.

Error localization:

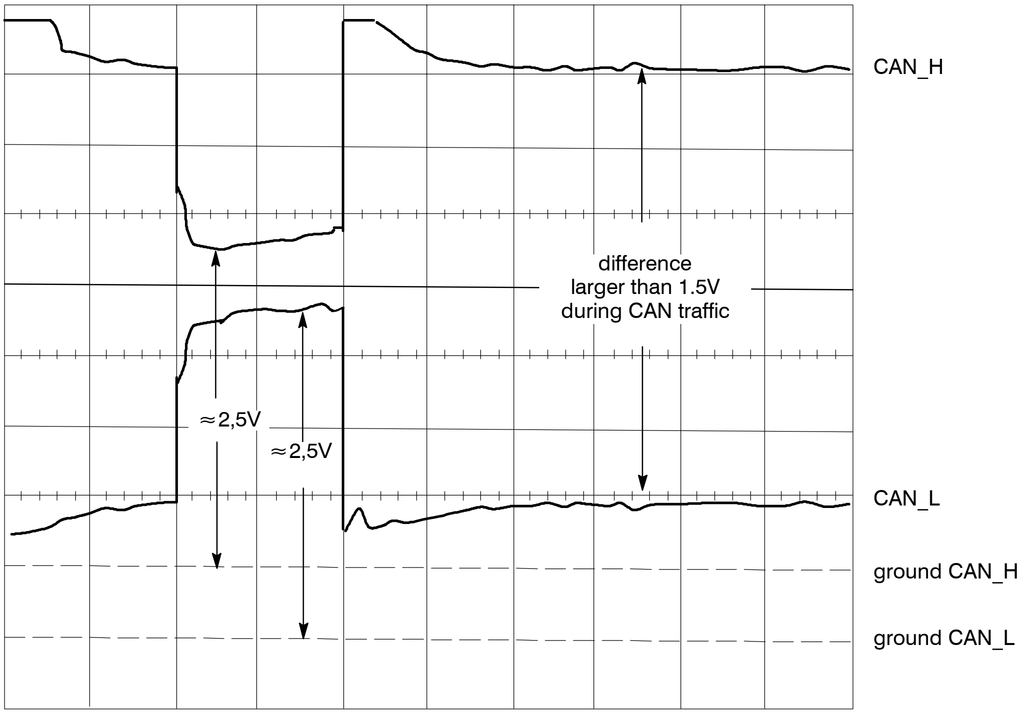
1. Entries in the error memory clearly indicate that the assembly and PCB are not communicating properly or not at all.

2. Control measurement of CAN levels with an oscilloscope during data transmission and in the quiescent status: Data transmission is triggered by pressing any desk button.
   If the levels are outside the tolerance or are not symmetrical, the CAN driver of an assembly or PCB is faulty. Because all the users are connected to the bus in parallel, the troublemaker can only be found by disconnecting one user after another.

Caution!
Disconnection must only take place with the generator switched OFF.

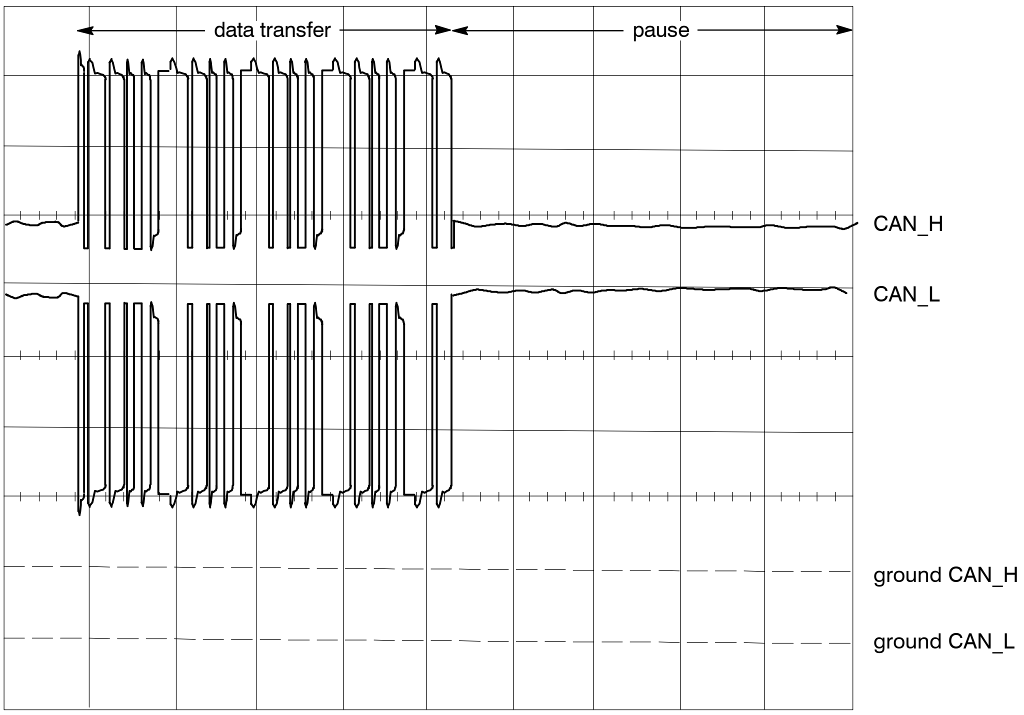
CAN levels with a high temporal resolution:
(Diagram 1)

500mV/div DC 2µs/div



CAN levels with low temporal resolution:
(Diagram 2)

500mV/div DC 100µs/div



197H96

11. Incorrect exposure indicator

General causes:

An incorrect exposure is indicated on the control desk if an exposure cannot be terminated according to the parameters set. Frequent causes of underexposure are the following:

1. The operator lets go of the release switch prematurely.
2. The measuring chamber is incorrectly programmed, not connected or faulty.

   Check the following:
   - RGDV programming
   - Programming of Amplimat sensitivity
   - Programming of EZ150 basic interface (gain, 15V/40V-supply)
   - Programming of screen/film combination (data set 1 ... 5)
3. The APR selected does not match the technique used or the screen/film combination.

   Check the following:
   - APR programming

The standard APRs supplied have parameters which generally match a 400-type screen/film combination. If the standard APRs are used, the exposure parameters have to be changed according to the speed of the screen/film combination actually used.
This also applies if an automatic technique is programmed as the preferred technique. In automatic techniques the mAs and ms-parameters are used for fault exposure detection.

Fault exposure detection AEC / TDC:

To protect patients there are 3 monitoring systems for automatic techniques:

1. Maximum mAs product:	Can be set by XRGSCOPE
2. Maximum exposure time or backup time:	Can be set by XRGSCOPE
3. Fault exposure detection:	The fault exposure detection can be switched ON or OFF via XRGSCOPE. Irrespective of this fault exposure detection does not perform if levels fall below certain limits.

AEC / AECF limits:

- Maximum mAs product: 580mAs (default)
- Maximum exposure time: 4s (cannot be changed)
- Backup time AEC: Exposure time based on 9.5 times the mAs of the respective manual technique (kV-mAs). 4s after overriding
- Backup time AECF: 9.5 times the exposure time of the respective manual technique (kV-mAs)
- Fault exposure detection: $\leq$ 4% dose at 10% backup time

Fault exposure detection is ignored under the following circumstances:

- Backup time: $\leq$ 100ms ($\leq$ 10ms at 10%)
- Switch OFF voltage (dose): $\leq$ 610mV ($\leq$ 24.4mV at 4%)

If there is a fault an exposure is aborted after about 10% of backup time. If the fault exposure detection fails to respond in the event of a fault, shutdown takes place after reaching backup time, max. exposure time or max. mAs product.

TDC limits:

- Maximum mAs product: 580mAs (default)
- Exposure time: 0.3 ... 6s
- Fault exposure detection: $\leq$ 10 ... 4% dose for 9.5 times the sample time

$$\text{dose minimum} = \frac{\text{9.5 x sample time}}{\text{exposure time (corr.)}} \text{ x 40\% nominal dose}$$

- Backup time: Exposure time
- Sample time: 25 ... 60ms = 1% exposure time (corr.); min. 25ms
- Sample steps: 12 ... 100

Fault exposure detection is ignored under the following circumstances:

- Exposure time: $<$ 1s

In the event of a fault the exposure is aborted after approx. 11 times sample time. If the fault exposure detection fails to respond in the event of a fault, shutdown takes place after reaching the backup time or the max. mAs product.

The switch OFF voltage should be at least 1.2V to guarantee good TDC regulation. Program the higher gain factor on EZ150 BASIC INTERFACE ($\geq$ 4512 108 05964), if necessary.

Programming possibilities:

- Select menu:
  PROGRAM/ APPLICATION LIMITS/ **X-MODE LIMITS**

  X-Ray Mode: AEC ... TDC
  Max. Current Time Product Limit: 580mAs

- Select menu:
  PROGRAM/ DOSE RATE CONTROL/ FAULT EXPOSURE DETECTION/ **AEC ... TDC**

  ON - OFF

Aids to fault finding:

- Select menu:
  FAULTFIND/ LOGGING TABLE/ X-RAY LOG/ DOSE RATE CONTROL LOGGING/ ...

... **READ ACTUAL STATUS**	Technique and parameters of the last exposure
... AEC/ **AEC CALCULATION**	Data of the selected APR with AEC or AECF
... AEC/ **AEC TRACE**	Control values of the last AEC exposure
... TDC/ **TDC CALCULATION**	Data of the selected APR with TDC
... TDC/ **TDC TRACE**	Control values of the last TDC exposure

Adjustment possibilities:

- Select menu:
  ADJUST/ DOSE RATE CONTROL/ **TDC AMPLIMAT**

P gain factor	(def. 50):		Do not change any value here without order from DMC Hamburg!
i gain factor	(def. 8):		
d gain factor	(def. 5):		
min. sample time	(def. 40) [ms]:	25 ... 65	

12. Mnemonic and routing list

Explanation:

MNEMONIC
explanation
signal chain (-direct connection = connection via relay contact) all possible units mentioned
signal value / range / signal source
measuring point (in ( ) at PCB front panel)
trigger point [preferred]
remarks
part of supply

AC_0V_XG
AC mains supply 0 V X–ray generator
ENX1101/2-EZX13:2-EZ102X1:DBZ4-EZ119X1:DBZ24 Optimus RAD
ENX3201-EZX13:2-EZ102X1:DBZ4-EZ119X1:DBZ24 Optimus R/F
neutral N of mains supply for EZ102 + EZ119

AC_230V_L1
AC mains supply 230VAC phase 1
ENF2:L1-ENF2:T1-ENK2:2-ENK2:1-EZX13:1-EZX102X1:DBZ2
AC mains supply for low voltage power supply EZ102

AC_230V_L2
mains supply 230V AC phase 2
ENF2:L2-ENF2:T2-ENK2:4-ENK2:3-EZX13:3-EZ119X1:DBZ26
AC mains supply for function unit mA_control EZ119

AV_HT_AN
high tension actual value anode side
0V ... +3.75V = 0 ... 75kV 1V = 20kV
measuring point EZ130 (X4)
[CRTL_X_C/ at EZX74]

AV_HT_CA
high tension actual value cathode side
0V ... +3.75V = 0 ... 75kV 1V = 20kV
measuring point EZ130 (X5)
cathode value also positive!
[CRTL_X_C/ at EZX74]

AV_HT
high tension actual value
0 ... +7.5V = 0 ... 150kV 1V = 20kV
measuring point EZ130 (X3)
[CRTL_X_C/ at EZX74]

CAN_H
generator CAN high active
-EZ119X2:C3-EZ130X2:C3-EZ139X2:C3-EZ150X2:C3-EZX44:10-EZX45:10-EZX46:10
-C300X1:10-EZX51:3-EZX151:3-EZX52:7-EZX72
-EWAX51:10-EWAX52:10-EWA100X2:C3-EWBX51:10-EWBX52:10-EWB100X2:C3
+2.5VDC standby, +3.2VDC during communication
EZX72
for communication of generator function units only
part of: XRG bus

CAN_L
generator CAN low active
-EZ119X2:A3-EZ130X2:A3-EZ139X2:A3-EZ150X2:A3-EZX44:2-EZX45:2-EZX46:2
-C300X1:2-EZX51:2-EZX151:2-EZX52:2-EZX71-EWAX51:2-EWAX52:2-EWA100X2:A3-EWBX51:2
-EWBX52:2-EWB100X2:A3
+2.5VDC standby, +1.5VDC during communication
EZX71
for communication of generator function units only
part of: XRG bus

CM_EX_SW_1
common for exposure switch of release decade 1
EWA100X1:C5-EWAX1:10
EWB100X1:C5-EWBX1:10
+26V non-active
exposure request

CM_EX_SW_2
common for exposure switch of release decade 2
EWA100X1:C7-EWAX2:10
EWB100X1:C7-EWBX2:10
+26V non-active
exposure request

CM_EX_SW_3
common for exposure switch of release decade 3
EWA100X1:C9-EWAX3:10
EWB100X1:C9-EWBX3:10
+26V non-active
exposure request

CM_EX_SW_4
common for exposure switch of release decade 4
EWA100X1:C11-EWAX4:10
EWB100X1:C11-EWBX4:10
+26V non-active
exposure request

CM_SW
common for radiation indication
EZ150X1:C29-EZX1:6-EWGX1:6-EWGX2:6-EWGX3:6
partner of SW_UN_EX, potential free contact

CM_TH
common for thermal sensor of tube housing
NTC temperature measurement in tube housing (not yet available)
EZ130X1:C12-EZX3:7-EWGX7:7-EWGX8:7-EWGX9:7 backpanel 4512 108 05983
EZ130X1:C12-EZX3:4-EWGX7:4-EWGX8:4-EWGX9:4 backpanels 4512 108 05984 + 4512 108 09361/2
partner of TH_OL

CM_TH_SW
common for tube housing temperature switch
EZ130X1:C11-EZX3:4-EWGX7:4-EWGX8:4-EWGX9:4 backpanel 4512 108 05983
EZ130X1:C11-EZX3:7-EWGX7:7-EWGX8:7-EWGX9:7 backpanels 4512 108 05984 + 4512 108 09361/2
partner of TH_OL_SW/

COM_EX_CD
common for exposure end signal and other warning signals
EWB102X1:A12-EWBX22:6
partner of EX_CD + SW_XG_RD_1 + SW_PR_FL_1 + SW_WN_FL_1 + SW_UN_EX_1

CTRL_X/
control X–ray request command, system level or with decade adaptation units WA/WB
EZ139X1:A4-EZX23:4-EZX45:5-EWAX51:5-EWAX52:5-EWA100X2:C25-EWBX51:5-EWBX52:5
-EWB100X2:C25
0V active, +15V inactive
EZX85
part of: signal bus

CTRL_X_C/
control X–ray request command, internal generator signal
EZ119X2:C6-EZ130X2:C6-EZ139X2:C6-EZ150X2:C6-EZX52:8
0V active, +5V inactive
EZX74 as preferred trigger signal for kV measurement
final high tension on command if all conditions ready
part of: XRG bus, CAN/XS bus

CU_CT1_1
cooling unit contact 1_1
EZ150X1:A22-EZX2:6-EWGX4:6=EGWX5:6=EWGX6:6

CU_CT1_2
cooling unit contact 1_2
EZ150X1:C22-EZX2:7-EWGX4:7=EWGX5:7=EWGX6:7

CU_U
stator current U
high speed rotor control units 4512 104 71421/461
EY100 X15
9.3A/V

CU_V
stator current V
high speed rotor control units 4512 104 71421/461
EY100 X16
9.3A/V

CU_W
stator current W
high speed rotor control units 4512 104 71421/461
EY100 X17
9.3A/V

CV1 EN/
CV2 EN/
converter 1/2 enable
converter 1: EZ130X1:A9-EZX24:22-EQ100X1:22
converter 2: EZ130X1:A30-EZX34:22-E2Q100X1:22
not used, no function

CV1_GND
converter power part 1 ground
EZ130X1:AC8-EZX24:8/21-EQ100X1:8/21
in combination with: CV2_ID/ signal release 2 generators
in combination with: CV2_IDA/ and CV2_IDB/ release 3 generators

CV1_GND_OL
converter power part 1 ground overload (generator basic version ≥ 4512 104 70203/70602)
EZ130X1:A7-EZX24:20-EQ100X1:20
not used, no function

CV1_ID/
converter power part 1 identification
EQ100X1:19-EZX24:19-EZ130X1:A6
open +5V, converter connected 0V
in combination with: CV1_GND signal
release 2 generators only

CV1_IDA/
converter power part 1 identification A
EQ100X1:19-EZX24:19-EZ130X1:A6
open +5V, converter connected +24mV
in combination with: CV1_GND signal
release 3 generators only

CV1_IDB/
converter power part 1 identification B
EQ100X1:21-EZX24:21-EZ130X1:C9
open +5V, converter connected +24mV
in combination with: CV1_GND signal
release 3 generators only

CV2_IDA/
converter power part 2 identification A
E2Q100X1:19-EZX34:19-EZ130X1:A27
open +5V, converter connected +24mV
in combination with: CV2_GND signal
release 3 generators only

CV2_IDB/
converter power part 2 identification B
E2Q100X1:21-EZX34:21-EZ130X1:C30
open +5V, converter connected +24mV
in combination with: CV2_GND signal
release 3 generators only

CV1_OL/
converter power part 1 overload
EQ100X1:7-EZX24:7-EZ130X1:C7
not used, no function

CV1_TM
converter power part 1 temperature
EQ100X1:6-EZX24:6-EZ130X1:C6
4.4V ... 1.5V = 20 ... 100 degrees C
in combination with: CV1_GND signal

CV2_GND
converter power part 2 ground
EZ130X1:AC29-EZX34:8/21-E2Q100X1:8/21
in combination with: CV2_ID/ signal release 2 generators
in combination with: CV2_IDA/ and CV2_IDB/ release 3 generators

CV2_GND_OL
converter power part 2 ground overload (generator basic version ≥ 4512 104 70203/70602)
EZ130X1:A28-EZX34:20-E2Q100X1:20
not used, no function

CV2_ID/
converter power part 2 identification
E2Q100X1:19-EZX34:19-EZ130X1:A27
open +5V, converter connected 0V
in combination with: CV2_GND signal
release 2 generators only

CV2_OL
converter power part 2 overload
E2Q100X1:7-EZX34:7-EZ130X1:C28
not used, no function

CV2_TM
converter power part 2 temperature
EZ130X1:C27-E2Q100X1:6-EZX34:6
4.4V...1.5V = 20...100 °C
in combination with: CV2_GND signal

DR_BV_0V
dose rate (signal) reference of image intensifier
EZX61:3-EZ139X2:C18 backpanel 4512 108 05983/4 only
negative potential of II unit, 0V +/-50mV against generator ground
differential signal with DR_BV_SG
not used, no function for generators release 2

DR_BV_NG
dose rate (signal) reference of image intensifier
EZX61:6-EZ139X2:C18 backpanel 4512 108 09361/2 only
negative potential of II unit, 0V +/-50mV against generator ground
differential signal with DR_BV_SG
part of: dose rate control

DR_BV_SG
dose rate signal of image intensifier
EZX61:8-EZ139X2:A18 backpanel 4512 108 05983/4 only
EZX61:4-EZ139X2:A18 backpanel 4512 108 09361/2 only
positive potential, 0 ... 10V
differential signal with DR_BV_NG
no function for generators release 2
part of: dose rate control

DR_FL_LO_1
dose rate fluoro lock-in 1
EWBX12:7-EWB100X1:A21

DR_FQ_NG
dose rate signal (pulses) negative
not used, no function

DR_FQ_PO
dose rate signal (pulses) positive
not used, no function

DR_LM
dose rate limiter
EWBX12:1-EWB100X1:A20
low_active if tubelift D76 / EZD on short SID (if tubelift option present)

DR_TV_NG
dose rate of TV chain signal negative, fluoro control
(II/TV_adapter_PCB_X3:1-X2:8)-EZX61:8-EZ139X2:C19 backpanel 4512 108 09361/2
+/-12V minus polarity
dual voltage differential signal
typically +6V in standby coming from TV chain
+V for more dose, -V for less dose, 0V stable image
part of: dose rate control

DR_TV_NT
dose rate of TV chain signal negative, fluoro control
EZX61:4-EZ139X2:C19 backpanel 4512 108 05983/4
not used, no function

DR_TV_PO
dose rate of TV chain signal positive, fluoro control
(II/TV_adapter_PCB_X3:3-X2:7)-EZX61:7-EZ139X2:A19 backpanel 4512 108 09361/2
-/+12V positive polarity
dual voltage differential signal
typically -6V in standby coming from TV chain
-V for more dose, +V for less dose, 0V stable image
part of: dose rate control

DR_TV_PT
dose rate of TV chain signal positive, fluoro control
EZX61:9-EZ139X2:A19 backpanel 4512 108 05983/4
not used, no function

DS_BV_NG
dose (signal ramp) reference of image intensifier
(II/TV_adapter_PCB_X1:P –X2:3)-EZX61:3-EZ139X2:C17 backpanel 4512 108 09361/2
negative potential of II unit, 0V +/-50mV against generator ground
differential signal with DS_BV_SG
part of: dose rate control

DS_BV_0V
dose (signal ramp) reference of image intensifier
EZX61:2-EZ139X2C17 backpanel 4512 108 05983/4
not used, no function

DS_BV_SG
dose signal ramp of image intensifier signal
EZX61:7-EZ139X2:A17 backpanel 4512 108 05983/4
(II/TV_adapter_PCB_X1:R-X2:2)-EZX61:2-EZ139X2:A17 backpanel 4512 108 09361/2
0 ... 10V, polarity positive
differential signal with DS_BV_NG release 3 generators only
release 2 generators: not used, no function
part of: dose rate control

DS_MC_0V
dose (signal ramp) reference of selected measuring chamber
EZ150X2:C16-EZ139X2:C16
negative potential of selected measuring chamber, 0V +/-50mV against generator ground
differential signal with DS_MC_SG

DS_MC_SG
dose signal ramp of selected measuring chamber
EZ150X2:A16-EZ139X2:A16
0 ... +12V
[EZ150 X4 against X5 ground]
differential signal with DS_MC_0V

E_NG_CV1
E value converter DC supply negative
converter 1 (frontal 50/65/80kW): EQ100X1:5-EZX24:5-EZ130X1:C5
0 ... -12V = 0 ... -375V if converter is stand-alone (EQ100 X1 not connected)
if in normal operation: E_PO + E_NG >> 445VDC = 10V measuring input EZ130 X1:A5 - X1:C5

E_NG_CV2
E value converter DC supply negative
converter 2 (rear 65/80kW): E2Q100X1:5-EZX34:5-EZ130X1:C26
no input to EZ130 release 2 generators
release 3 generators only with 2 converters
0 ... -12V = 0 ... -375V if converter is stand-alone (E2Q100 X1 not connected)
if in normal operation: E_PO + E_NG >> 445VDC = 10V measuring input EZ130 X1:A26 - X1:C26

E_PO_CV1
E value converter DC supply positive
converter 1: EQ100X1:18-EZX24:18-EZ130X1:A5
0 ... +12V = 0 ... +375V if converter is stand-alone (EQ100 X1 not connected)
if in normal operation: E_PO + E_NG >> 445VDC = 10V measuring input EZ130 X1:A5 - X1:C5

E_PO_CV2
E value converter DC supply positive
converter 2: E2Q100X1:18-EZX34:18-EZ130X1:A26
no input to EZ130 version 4512 108 08661..4 release 2 generators
release 3 generators only with 2 converters EZ130 version 4512 108 09102 ... 4
0 ... +12V = 0 ... +375V if converter is stand-alone (E2Q100 X1 not connected)
if in normal operation: E_PO + E_NG >> 445VDC = 10V measuring input EZ130 X1:A26 - X1:C26

EN_X/
enable X–ray, system level
preparation or fluoro request, only valid in combination with CAN message (RAD-R/F)
or hardware requests (Optimus C)
EZ139X1:C2-EZX10:1/3-EZX23:15-EZX45:11-EZX46:11-C300X1:11-EWAX51:11-EWAX52:11
-EWA100X2:C26-EWBX51:11-EWBX52:11-EWB100X2:C26
measuring point: EZX82, EZ139X9
part of: signal bus
0V/+15V low active

EX_CD
exposure end signal
contact to drive e.g. an external buzzer
partner of COM_EX_CD

EN_X_C/
enable X–ray, internal generator signal
preparation or fluoro request if confirmed by CAN message (RAD-R/F)
or hardware requests (Optimus C)
EZ119X2:C7-EZ130X1:C7-EZ130X2:C7-EZ139X2:C7-EZ150X2:C7-EZX52:9-EZX76
0V/+5V low active
measuring point EZX76
driven by CU if EN_X/ active (low)
part of: XS/XRG bus

EX_ON
exposure on
EWA100X2:A9-EWAX14:7
EWB100X2:A9-EWBX14:7
potential free optocoupler driven signal
in combination with IT_0V
supply: max 26V 10mA
part of: EXON old world

FD_C_CH1
central field measuring chamber 1
EZ150X1:C4-EZX21:12
+15V, Ri of EZ150 = 220Ω

FD_C_CH2
central field measuring chamber 2
EZ150X1:A4-EZX22:12
+15V, Ri of EZ150 = 220Ω

FD_C_CH3
central field measuring chamber 3
EZ150X1:C10-EZX31:12
+15V, Ri of EZ150 = 220Ω

FD_C_CH4
central field measuring chamber 4
EZ150X1:A10-EZX32:12
+15V, Ri of EZ150 = 220Ω

FD_C_CH5
central field measuring chamber 5
EZ150X1:C16-EZX41:12
+15V, Ri of EZ150 = 220Ω

FD_L_CH1
left field measuring chamber 1
EZ150X1:C3-EZX21:11
+15V, Ri of EZ150 = 220Ω

FD_L_CH2
left field measuring chamber 2
EZ150X1:A3-EZX22:11
+15V, Ri of EZ150 = 220Ω

FD_L_CH3
left field measuring chamber 3
EZ150X1:C9-EZX31:11
+15V, Ri of EZ150 = 220Ω

FD_L_CH4
left field measuring chamber 4
EZ150X1:A9-EZX32:11
+15V, Ri of EZ150 = 220Ω

FD_L_CH5
left field measuring chamber 5
EZ150X1:C15-EZX41:11
+15V, Ri of EZ150 = 220Ω

FD_R_CH1
right field measuring chamber 1
EZ150X1:C5-EZX21:3
+15V, Ri of EZ150 = 220Ω

FD_R_CH2
right field measuring chamber 2
EZ150X1:A5-EZX22:3
+15V, Ri of EZ150 = 220Ω

FD_R_CH3
right field measuring chamber 3
EZ150X1:C11-EZX31:3
+15V, Ri of EZ150 = 220Ω

FD_R_CH4
right field measuring chamber 4
EZ150X1:A11-EZX32:3
+15V, Ri of EZ150 = 220Ω
FD_R_CH5
right field measuring chamber 5
EZ150X1:C17-EZX41:3
+15V, Ri of EZ150 = 220Ω

FI_TF1_1
filament transformer 1 line 1
EZ119X1:DBZ4-EZX12:1-EG106X15:1
square pulses 100 ... 20kHz, amplitude ~ 300V

FI_TF1_2
filament transformer 1 line 2
EZ119X1:DBZ6-EZX12:2-EG106X15:2
square pulses 100 ... 20kHz, amplitude ~ 300V

FI_TF2_1
filament transformer 2 line 1
EZ119X1:DBZ8-EZX12:4-EG106X15:4
square pulses 100 ... 20kHz, amplitude ~ 300V

FI_TF2_2
filament transformer 2 line 2
EZ119X1:DBZ10-EZX12:5-EG106X15:5
square pulses 100 ... 20kHz, amplitude ~ 300V

GND
ground
-EZ102X1:DBZ6-EZ119X1:DBZ26-EZ102X2:DBZ8/10/12/14/16/18/20/26/30-EZ119X2:AC4/5/13/15/16/32
-EZ130X2:C16:AC4/5/13/15/32-EZ139X2:AC4/5/13/15/32-EZ150X2:AC4/5/13/15/32-EZX21:13
-EZX22:13-EZX31:13-EZX32:13-EZX41:13-EZX12:3/6-EZX51:11/12/13/14/15-EZX151:X11/12/13/14/15
-EZX44:1/7-EZX46:8/13-EZX1:9-EZX2:10-EZX3:10-EZX5-EZX6-EZX7:3-EZX8:3-EZX17:2-EZX18:2
-EZX19:2-EZX20:2
-EWGX11:4-EWGX12:4-EWGX1:9-EWGX2:9-EWGX3:9-EWGX4:10-EWGX5:10
-EWGX6:10-EWGX7:10-EWGX8:10-EWGX9:10
-EWAX41:2-EWAX42:2-EWAX51:15-EWAX52:15
-EWAX1:7-EWAX2:7-EWAX3:7-EWAX4:7-EWAX11:2-EWAX11:4-EWAX11:6-EWAX11:9-EWAX12:2
-EWAX12:4-EWAX12:6-EWAX12:9-EWAX13:9-EWAX14:9-EWAX21:10-EWAX23:10-EWAX24:1
-EWAX24:10
-WA102X1AC2-WA102X2:AC15/28
-EWBX41:2-EWBX42:2-EWBX51:15-EWBX52:15-EWBX1:7-EWBX2:7-EWBX3:7-EWB4:7
-EWBX11:2-EWBX11:9-EWBX12:10-EWBX13:4-EWBX13:6-EWBX21:6-EWBX22:10-EWBX23:10
-EWBX24:1-EWBX24:10
-WB102X1AC2-WB102X2:AC15/28
-EYAX1:15/16/17-EYAX2:1-EY100X1:11/12/13/14/15-EY100X13-EY100X41
-C200X1:2-C200X2:17/18/19/20-X100X1:17/18/19/20-C100X10-C100X2:6/7/8/9/10-C300X4:6/7/8/9/10
-C300X2:1/5
-EZX87- (cannot be used as signal ground at Duo Diagnost, only Optimus RAD-R/F)

GND_15V
ground (+15V) for desk hand switch
C300X3:1/2/6

HT_AN
high tension anode side actual value
EG100X14:2-EZX35:2-EZ130X1:C17
0 ... +10V = 0 ... +100 kV measured at 10kOhm (20kΩ measuring circuit parallel to 20kΩ kV_control)

HT_AN_GND
high tension anode side ground
EG100X14:10-EZX35:10-EZ130X1:A17
0V

HT_CA
high tension cathode side actual value
EG100X14:1-EZX35:1-EZ130X1:C16
0 ... -10V = 0 ... -100kV measured at 10kOhm (20kΩ measuring circuit parallel to 20kΩ kV_control)

HT_CA_GND
high tension cathode side ground
EG100X14:9-EZX35:9-EZ130X1:A16
0V

I1_1
partner of I1_1/ optocoupler signal IGBT1 power part 1

EQ100	= 4512 108 05882	release 2
EQ100	≥ 4512 108 08621 *	release 2
EQ100	≥ 4512 108 09341 *	release 3

EZ130X1:A1-EZX24:14-EQ100X1:14

measuring point: EQ100 R25	end to X1	* EQ100 X6
value: on = 3.7V off = 1.2V	against ground	* = X10

I1_1/
partner of I1_1 optocoupler signal IGBT1 power part 1

EQ100	= 4512 108 05882	release 2
EQ100	≥ 4512 108 08621 *	release 2
EQ100	≥ 4512 108 09341 *	release 3

EZ130X1:C1-EZX24:1-EQ100X1:1

I1_2
partner of I1_2/ optocoupler signal IGBT2 power part 1
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:A2-EZX24:15-EQ100X1:15

I1_2/
partner of I1_2 optocoupler signal IGBT2 power part 1
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:C2-EZX24:2-EQ100X1:2
measuring point: EQ100 R27 end to X1 * EQ100 X7
value: ON = 3.7V OFF = 1.2V against ground * = X10

I1_3
partner of I1_3/ optocoupler signal IGBT3 power part 1
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:A3-EZX24:16-EQ100X1:16

I1_3/
partner of I1_3 optocoupler signal IGBT3 power part 1
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:C3-EZX24:3-EQ100X1:3
measuring point: EQ100 R29 end to X1 * EQ100 X8
value: ON = 3.7V OFF = 1.2V against ground * = X10

I1_4
partner of I1_4/ optocoupler signal IGBT4 power part 1
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:A4-EZX24:17-EQ100X1:17

I1_4/
partner of I1_4 optocoupler signal IGBT4 power part 1
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:C4-EZX24:4-EQ100X1:4
measuring point: EQ100 R31 end to X1 * EQ100 X9
value: ON = 3.7V OFF = 1.2V against ground * = X10

I2_1
partner of I2_1/ optocoupler signal IGBT1 power part 2
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:A22-EZX34:14-E2Q100X1:14

I2_1/
partner of I2_1 optocoupler signal IGBT1 power part 2
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:C22-EZX34:1-E2Q100X1:1
measuring point: EQ100 R25 end to X1 * E2Q100 X6
value: ON = 3.7V OFF = 1.2V against ground * = X10

I2_2
partner of I2_2/ optocoupler signal IGBT2 power part 2
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:A23-EZX34:15-E2Q100X1:15

I2_2/
partner of I2_2 optocoupler signal IGBT2 power part 2
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:C23-EZX34:2-E2Q100X1:2
measuring point: EQ100 R27 end to X1 * E2Q100 X7
value: ON = 3.7V OFF = 1.2V against ground * = X10

I2_3
partner of I2_3/ optocoupler signal IGBT3 power part 2
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:A24-EZX34:16-E2Q100X1:16

I2_3/
partner of I2_3 optocoupler signal IGBT3 power part 2
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:C24-EZX34:3-E2Q100X1:3
measuring point: EQ100 R29 end to X1 * E2Q100 X8
value: ON = 3.7V OFF = 1.2V against ground * = X10

I2_4
partner of I2_4/ optocoupler signal IGBT4 power part 2
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:A25-EZX34:17-E2Q100X1:17

I2_4/
partner of I2_4 optocoupler signal IGBT4 power part 2
EQ100 = 4512 108 05882 release 2
EQ100 ≥ 4512 108 08621 * release 2
EQ100 ≥ 4512 108 09341 * release 3
EZ130X1:C25-EZX34:4-E2Q100X1:4
measuring point: EQ100 R31 end to X1 * E2Q100 X9
value: ON = 3.7V OFF = 1.2V against ground * = X10

IT_0V
emitter 0V exposure on signal
EWA100X2:C9-EWAX14:9
EWB100X2:C9-EWBX14:9
potential free optocoupler driven signal
in combination with EX_ON
part of: EXON old world

Iu
stator current phase U of Low Speed Rotor Control
measuring point EYAX22
10A/V

Iw
stator current phase W of Low Speed Rotor Control
measuring point EYAX21
10A/V

MN_EM_OF
mains power emergency off
EZX4:1-EZX47:6-EN100X1:6

MN_ON
mains on
C300X1:6-EZX46:6-EZX47:2-EN100X1:2-EZX44:14 Optimus RAD – R/F
CB100X10:3-EZX46:6-EZX47:2-EN100X1:2-EZX44:14 Optimus C

NG_15V
-15V supply Vee
EZ102X2:DBZ24-EZ119X2:AC12-EZ130X2:AC12-EZ139X2:AC12-EZ150X2:AC12-EZX21:6-EZX22:6
-EZX31:6-EZX32:6-EZX41:6-EZX35:15-EZX51:8-EZX151:8-EG100X14:15
-14.5V ... -15.5V

NR_PR_X/
not ready preparing for X–ray
EZ139X1:A3-EZX23:3-EZX45:4-EZX46:4-C300X1:4-EWAX51:4-EWAX52:4-EWA100X2:A24-EWBX51:4
-EWBX52:4-EWB100X2:A24
driven by CU and/or system controller
measuring point: EZX83
part of: signal bus
0V/+15V high active

PO_0V
signal bus ground GNDS
EZ139X1:AC1-EZX23:1/14-EZX44:15-EZX45:15-EWAX51:15-EWAX52:15-EWBX51:15-EWBX52:15
part of: signal bus, supply via X44 Optimus RAD+R/F, from Cockpit at Duo Diagnost systems

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PO_12V
+12 V supply
EN100X1:1-EZX47:1-EZX46:7-C300X1:7

PO_15V
+15V supply Vdd
EZ102X2:DBZ22-EZ119X2:AC11-EZ130X2:AC11-EZ139X2:AC11
-EZ150X2:AC11-EZX2:8/9-EZX35:7-EZX44:12/13-EZX46:5
-EZX51:7-EG100X14:7-C300X1:5
-EZX21/22/31/32/41:5 backpanel 4512 108 05983 only
-EZX151:7 backpanels 4512 108 05984 + 4512 108 09361/2 only
+14.5V ... +15.5V

PO_15/40V
+15V or +40V supply for measuring chamber
EZ150X1:A20-EZX21/22/31/32/41:5EZ150 version ≥ 4512 108 05964
EZX21/22/31/32/41:5 via (15/40V Sub-D/3+ adapter) EZX21/22/31/32/41:L EZ150 version 4512 108 05963

PO_26V
+26V supply
EZ102X2:DBZ28-EZ119X2:AC14-EZ130X2:AC14-EZ139X2:AC14-EZ150X2:AC14-EZX1:5-EZX2:3
-EZX3:9-EZX11:1-EWGX11:1-EWGX12:1-EZX17:1-EZX18:1-EQ100X2:1-E2Q100X2:1

PO_26V_1
+26V supply options
EZ102X2:DBZ32-EZX19:1-EZX20:1-
-EWAX1:4-EWAX2:4-EWAX3:4-EWAX4:4-EWAX41:1-EWAX42:1-EWAX23:9-EWAX24:5
-EWA100X2:AC14-EWBX1:4-EWBW2:4-EWBX3:4-EWBX4:4-EWBX41:1-EWAX42:1-EWBX21:9
-EWBX22:9- EWBX23:9-EWBX24:5-EWB100X2:AC14
-EZX8:1 backpanels 4512 108 05984 + 4512 108 09361/2

PO_26V_RE
+26V reverse supply
EWAW11-EWAW12-EWAX1/2/3/4:4-EWAX42:1
if generator and system release voltages do not match
normal condition: PO_26V_RE = +26V of generator against ground
(jumper WA W11 + W13 closed, W12 open)
special condition: PO_26V_RE = 0V against -24V, supply from stand
(jumper WA W11 + W13 open, W12 closed)

PO_26V_SW
+26V supply switched, for cooling fan low voltage power supply
EZ102X1:D32-EZX7:1-EM1 backpanels 4512 108 05984 + 4512 108 09361/2

PO_40V
+15V or + 40V supply for measuring chamber
EZ150X1:A20-EZX21/22/31/32/41:5 EZ150 version ≥ 4512 108 05964
EZX21/22/31/32/41:5 via (15/40V Sub-D/3+ adapter) EZX21/22/31/32/41:L EZ150 version 4512 108 05963

PO_400V
+400V supply measuring chamber
EZ150X1:AC1-EZX21/22/31/32/41:1
+400V, Ri of EZ150 = 100kOhms

PO_5V
+5V supply Vcc
EZ102X2:DBZ2/4/6-EZ119X2:AC1/2-EZ130X2:AC1/2-EZ139X2:AC1/2-EZ150X2:AC1/2-EZX46:9-C300X1:9
-EZX51:4/5/6-EZX151:4/5/6
+4.74V ... +5.25V

PO_V
signal bus supply
EZX23:13/25-EZX44:5-EZX45:7-EZ139X1:AC6
(V15S = -EWAX51:7-EWAX52:7-EWA100X2:AC27-EWBX51:7-EWBX52:7-EWB100X2:AC27)
+15V Vsgn, supply via X44 Optimus RAD+R/F, from Cockpit at DuoDiagnost systems
part of: signal bus

POWERFAIL/
power fail signal of low voltage power supply, initiates warm-boot if supply voltage phase L1 drops below 196VAC
EZ102X1:D30-EZ139X1:A10

PW_ON_NG
relay power on negative, energizes ENK1 if generator ready
EZ130X1:A15-EZX47:9-EN100X1:9
partner of PW_ON_PO
0V/+15V (pulled up by relay coil EN100 K2), low active

PW_ON_PO
supply relay power on positive,
EZ130X1:C15-EZX47:4-EN100X1:4
partner of PW_ON_NG
+15V

RC_ON/
rotor control on, low speed rotor control only

EZ150X1:A25-EZX51:1	backpanel	4512 108 05983
EZ150X1:A25-EZX51:1-EZX151:1	backpanels	4512 108 05984 + 4512 108 09361/2

measuring point EYAX28

RC_RD/
rotor control ready, low speed rotor control only

EYAX1:9-EXZ51:9-EZ150X1:C25	backpanel	4512 108 05983
EYAX1:9-EXZ51:9-EZX151:9-EZ150X1:C25	backpanels	4512 108 05984 + 4512 108 09361/2

measuring point EYAX25

RC_ST_2/
rotor control stator 2

EZ150X1:A26-EZX16:1-EWGX14:1	low speed rotor control
EY100X3:1-EWGX14:1	high speed rotor control

RC_ST_3/
rotor control stator 3

EZ150X1:C26-EZX16:2-EWGX14:2-EWGX15:1	low speed rotor control
EY100X3:2-EWGX14:2-EWGX15:1	high speed rotor control

RD_MN_ON
ready mains power on

C100X2:50-C300X4:50-C300X1:14-EZX46:14-EZX47:7-EN100X1:7	Optimus RAD – R/F
CB100X10:4- EZX46:14-EZX47:7-EN100X1:7	Optimus C

RD_PR_X
NR_PR_X/
ReaDy preparing for X-ray or Not Ready preparing for X–ray
EZ139X1:A3-EZX23:3-EZX45:4-EZX46:4-C300X1:4- -EWAX51:4-EWAX52:4-EWA100X2:A24
driven by CU or other system components
measuring point: EZX83
part of: signal bus
0V/+15V high active signal

REL_CH1
release (reset integrator) chamber 1
EZ150X1:C6-EZX21:4
0V/+15V, typically +13V, high active

REL_CH2
release (reset integrator) chamber 2
EZ150X1:A6-EZX22:4
0V/+15V, typically +13V, high active

REL_CH3
release (reset integrator) chamber 3
EZ150X1:C12-EZX31:4
0V/+15V, typically +13V, high active

REL_CH4
release (reset integrator) chamber 4
EZ150X1:A12-EZX32:4
0V/+15V, typically +13V, high active

REL_CH5
release (reset integrator) chamber 5
also used as EXON signal for DSI
EZ150X1:C18-EZX41:4
0V/+15V, typically +13V, high active

RESET_1
external reset
resets incorrect, exposure indication, 5min fluoro buzzer, errors
EWBX22:7-EWB100X1:C23
0V/+26V low active

RESET_C/
internal RESET command for function units
EZ119X2:A6- EZ130X2:A6-EZ139X2:A6-EZ150X2:A6-EZX52:3-EZX45:3-EZX46:3-C300X1:3
-EZX51:10-EZX73-EWAX51:3-EWAX52:3-EWA100X1:A6-EWBX51:3-EWBX52:3-EWB100X1:A6-
-EZX151:10 backpanels 4512 108 05984 + 4512 108 09361/2
0V/+5V
measuring point EZX73
driven by CU, active (low) if: EZ139 S1 activated, RESET_SW/ ON signal bus active,
threatening power supply drop in, watchdog alarm, switch ON or warm-start,
resets FU's
part of: XS/XRG bus

RESET_SW/
signal bus reset, generator reset with turn-ON or push of turn-ON button as warm-start
EZX23:2-EZX44:6-EZ139X1:A2
0V/+15V low active
time constant ≥ 200ms
resets CU only
measuring point: EZX81
part of: signal bus

RF_0V_CH1
0V reference value measuring chamber 1
EZX21:8-EZ150X1:C8
differential signal with SIGN_CH1

RF_0V_CH2
0V reference value measuring chamber 2
EZX22:8-EZ150X1:A8
differential signal with SIGN_CH2

RF_0V_CH3
0V reference value measuring chamber 3
EZX31:8-EZ150X1:C14
differential signal with SIGN_CH3

RF_0V_CH4
0V reference value measuring chamber 4
EZX32:8-EZ150X1:A14
differential signal with SIGN_CH4

RF_0V_CH5
0V reference value measuring chamber 5
EZX41:8-EZ150X1:C20
differential signal with SIGN_CH5

RG_DV_1
registration device 1 selected
EWA100X1:C4-EWAX1:5
EWB100X1:C4-EWBX1:5

RG_DV_2
registration device 2 selected
EWA100X1:A7-EWAX2:5
EWB100X1:A7-EWBX2:5

RG_DV_3
registration device 3 selected
EWA100X1:A9-EWAX3:5
EWB100X1:A9-EWBX3:5

RG_DV_4
registration device 4 selected
EWA100X1:A11-EWAX4:5
EWB100X1:A11-EWBX4:5

RG_DV_SL_1
registration device selection 1
cassette / camera switchover signal
EWBX21:1-EWB100X1:C18
0V/+26V low active
partner of RG_DV_SL_2, only one of these should be low active at a time

RG_DV_SL_2
registration device selection 2
camera / cassette switchover signal
EWBX21:2-EWB100X1:A19
0V/+26V low active
partner of RG_DV_SL_1, only one of these should be low active at a time

RM_DR_0V
room door contact 0V
EZ150X1:C28-EZX1:10-EWGX1:10-EWGX2:10-EWGX3:10
release 2 generators only, not used release 3 RAD-R/F and Optimus C
partner of RM_DR_CT signal release 2 RAD generators only
0V/+26V low active, detects room door contact signal short circuit at release 2 RAD generators during turn-ON

RM_DR_CT
room door contact
EZ150X1:A28-EZX1:8-EWGX1:8=EWGX2:8=EWGX3:8 backpanels 4512 108 05983/4
EZ150X1:A28-EZX45:8-EWBX51:8-EWBX52:8-EWBX22:8-EZX1:8-EWGX1:8=EWGX2:8=EWGX3:8
backpanels 4512 108 09361/2
partner of RM_DR_0V signal release 2 RAD generators only
0V/+26V low active = door closed

RQ_M1_X/
request mode 1 (fluoro)
Optimus C only, not used
EZX23:9-EZ139X1:C4

RQ_M2_X/
request mode 2 (exposure)
Optimus C only, not used
EZX23:22-EZ139X1:C5

RQ_M3_X/
request mode 3
Optimus C only, not used
EZX23:10-EZ139X1:C7

RQ_SN_X/
request synchronization of X-ray, exposure request signal
EZX23:16-EZX45:12-EZX46:12-C300X1:12-EZ139X1:C3-EWAX51:12-EWAX52:12-EWA100X2:A25
-EWBX51:12-EWBX52:12-EWB100X2:A25
measuring point: EZX84
0V/+15V
part of: signal bus

RQ_XG_EX
request X–ray generator for exposure
EWAX1:1- EWAX1:2- EWAX1:3- EWAX1:4-EWA100X1:A3
EWBX1:1- EWBX1:2- EWBX1:3- EWBX1:4-EWB100X1:A3
0V/+26V low active, high if waiting for sync contact
partner of XG_RD_EX for grid sync (20-21)

RQ_XG_FL
request X–ray generator for fluoroscopy
EWAX1:6-EWAX2:6-EWAX3:6-EWAX4:6-EWA100X1:A5 not possible with WA
EWBX1:6-EWBX2:6-EWBX3:6-EWBX4:6-EWB100X1:A5
0V/+26V low active

RQ_XG_PR_1
request X–ray generator for preparation
EWAX1:3-EWA100X1:A4
EWBX1:3-EWB100X1:A4
0V/+26V low active

RQ_XG_PR_2
request X–ray generator for preparation
EWAX2:3-EWA100X1:C6
EWBX2:3-EWB100X1:C6
0V/+26V low active

RQ_XG_PR_3
request X–ray generator for preparation
EWAX3:3-EWA100X1:C8
EWBX3:3-EWB100X1:C8
0V/+26V low active

RQ_XG_PR_4
request X–ray generator for preparation
EWAX4:3-EWA100X1:C10
EWBX4:3-EWB100X1:C10
0V/+26V low active

RX_CAN_1
system CAN 1 optional
EZX44:3-EZ139X1:C15

RX_CAN_2
system CAN 2 optional
EZX43:1-EZX44:11

S_CAN_GND
system CAN bus ground
EZ139X1:C17-EZX42:3/6-EZX43:3/6-EZX44:9
-(EZX44:9- EZX44:1- to GND via function programming plug 4512 130 54441 Optimus RAD only)
part of: system CAN

S_CAN_L
system CAN low active
EZ139X1:C16-EZX42:2-EZX43:2
+2.5VDC standby, +1.5VDC during communication
part of: system CAN

S_CAN_H
system CAN high active
EZ139X1:A16-EZX42:7-EZX43:7
+2.5VDC standby, +3.2VDC during communication
part of: system CAN

S_CAN_PO
system CAN supply
EZX44:4-EZX42:9-EZX43:9-EZ139X1:A17
-(EZX44:12-EZX44:9 supply via function programming plug 4512 130 54441 Optimus RAD only)
typically +12V, Vcan
part of: system CAN

SI_PH/
single phase identifier
EN100X1:5-EZX47:5-EZ130X1:C14

SI_PH_ID
single phase identifier
EN100X1:5-EZX47:5-EZ130X1:C14

SIGN_CH1
dose signal of measuring chamber 1
EZX21:7-EZ150X1:C7
0 ... 12V (24V out of range possible)
differential signal with RF_0V_CH1

SIGN_CH2
dose signal of measuring chamber 2
EZX22:7-EZ150X1:A7
0 ... 12V (24V out of range possible)
differential signal with RF_0V_CH2

SIGN_CH3
dose signal of measuring chamber 3
EZX31:7-EZ150X1:C13
0 ... 12V (24V out of range possible)
differential signal with RF_0V_CH3

SIGN_CH4
dose signal of measuring chamber 4
EZX32:7-EZ150X1:A13
0 ... 12V (24V out of range possible)
differential signal with RF_0V_CH4

SIGN_CH5
dose signal of measuring chamber 5
EZX41:7-EZ150X1:C19
0 ... 12V (24V out of range possible)
differential signal with RF_0V_CH5

SL_CO_1
select correction 1
external patients size correction, slim patient
EWA100X1:A32-EWAX24:8
EWB100X1:A32-EWBX24:8
0V/+26V low active for selection or when selected from generator desk

SL_CO_2
select correction 2
external patients size correction, stout patient
EWA100X1:C32-EWAX24:9
EWB100X1:C32-EWBX24:9
0V/+26V low active for selection or when selected from generator desk

SL_PG_1
select external APRT program 1
EWA100X1:A28-EWAX23:1
EWB100X1:A28-EWBX23:1
0V/+26V low active for selection or when selected from generator desk

SL_PG_2
select external APRT program 2
EWA100X1:C28-EWAX23:2
EWB100X1:C28-EWBX23:2
0V/+26V low active for selection or when selected from generator desk

SL_PG_3
select external APRT program 3
EWA100X1:A29-EWAX23:3
EWB100X1:A29-EWBX23:3
0V/+26V low active for selection or when selected from generator desk

SL_PG_4
select external APRT program 4
EWA100X1:C29-EWAX23:4
EWB100X1:C29-EWBX23:4
0V/+26V low active for selection or when selected from generator desk

SL_PG_5
select external APRT program 5
EWA100X1:A30-EWAX23:5
EWB100X1:A30-EWBX23:5
0V/+26V low active for selection or when selected from generator desk

SL_PG_6
select external APRT program 6
EWA100X1:C30-EWAX23:6
EWB100X1:C30-EWBX23:6
0V/+26V low active for selection or when selected from generator desk

SL_PG_7
select external APRT program 7
EWA100X1:A31-EWAX23:7
EWB100X1:A31-EWBX23:7
0V/+26V low active for selection or when selected from generator desk

SL_PG_8
select external APRT program 8
EWA100X1:C31-EWAX23:8
EWB100X1:C31-EWBX23:8
0V/+26V low active for selection or when selected from generator desk

SL_TO_TM_1
select tomo time 1
tomo time input from stand
EWAX21:1-EWA100X1:A24
0V/+26V low active

SL_TO_TM_2
select tomo time 2
tomo time input from stand
EWAX21:2-EWA100X1:C24
0V/+26V low active

SL_TO_TM_3
select tomo time 3
tomo time input from stand
EWAX21:3-EWA100X1:A25
0V/+26V low active

SL_TO_TM_4
select tomo time 4
tomo time input from stand
EWAX21:4-EWA100X1:C25
0V/+26V low active

SL_TO_TM_5
select tomo time 5
tomo time input from stand
EWAX21:5-EWA100X1:A26
0V/+26V low active

SL_TO_TM_6
select tomo time 6
tomo time input from stand
EWAX21:6-EWA100X1:C26
0V/+26V low active

SL_TO_TM_7
select tomo time 7
tomo time input from stand
EWAX21:7-EWA100X1:A27
0V/+26V low active

SL_TO_TM_8
select tomo time 8
tomo time input from stand
EWAX21:8-EWA100X1:C27
0V/+26V low active

SL_XG_TO
select X–ray generator for tomography
EWAX11:3-EWAX12:3-EWA100X1:C18
0V/+26V, low active

STOP_X_C/
stop X–ray command, X–ray OFF from function units mA and dose rate control (on-board of CU)
EZ119X2:A7-EZ130X2:A7- EZ139X2:A7-EZ150X2:A7-EZX52:4
0V/5V
measuring point EZX75
inactivates CTRL_X_C/
EXOF exposure OFF command
part of: XS/XRG bus

STU
stator phase U
EYAX2:2-EX1101 low speed rotor control single tube

EYAX2:2-EWGK11:1-EWGK12:1=EWGK11:2=EWGK12:2	low speed two tubes
EY100X46:2-EX1101	high speed rotor control vers. 4512 104 33791/2 or 71401..6 single tube
EY100X46:2-EWGK11:1-EWGK12:1=EWGK11:2=EWGK12:2	high speed rotor control vers. 4512 104 33791/2 or 71401..6 two tubes
EY100X51-EX1101	high speed rotor control vers. 4512 104 71421/61 single tube
EY100X51--EWGK11:1-EWGK12:1=EWGK11:2=EWGK12:2	high speed rotor control vers. 4512 104 71421/61 two tubes

STV
stator phase V = common

EYAX2:3-EX1102	low speed rotor control single tube
EYAX2:3-EWGK11:3-EWGK12:3=EWGK11:4=EWGK12:4	low speed two tubes
EY100X47:1-EX1102	high speed rotor control vers. 4512 104 33791/2 or 71401..6 single tube
EY100X47:1-EWGK11:3-EWGK12:3=EWGK11:4=EWGK12:4	high speed rotor control vers. 4512 104 33791/2 or 71401..6 two tubes
EY100X52-EX1102	high speed rotor control vers. 4512 104 71421/61 single tube
EY100X52--EWGK11:3-EWGK12:3=EWGK11:4=EWGK12:4	high speed rotor control vers. 4512 104 71421/61 two tubes

STW
stator phase W

EYAX2:4-EX1103	low speed rotor control single tube
EYAX2:4-EWGK11:5-EWGK12:5=EWGK11:6=EWGK12:6	low speed two tubes
EY100X47:2-EX1103	high speed rotor control vers: 4512 104 33791/2 or 71401..6 single tube
EY100X47:2-EWGK11:5-EWGK12:5=EWGK11:6=EWGK12:6	high speed rotor control vers. 4512 104 33791/2 or 71401..6 two tubes
EY100X53-EX1103	high speed rotor control vers. 4512 104 71421/61 single tube
EY100X53--EWGK11:5-EWGK12:5=EWGK11:6=EWGK12:6	high speed rotor control vers. 4512 104 71421/61 two tubes

SW_BU_1
switch bucky 1 ready (WA + WB)
EWAX11:10-EWA100X1:C19
EWBX11:10-EWB100X1:C19
part of: bucky ready contact
0V/+26V low active

SW_BU_2
switch bucky 2 ready (WA only)
EWAX12:10-EWA100X1:A21
part of: bucky ready contact
0V/+26V low active

SW_OF_FD_1
switch OFF field 1
format size correction < 14cm or if cone in use serial changer chamber
EWBX13:5-EWB100X1:C21
0V/+26V low active

SW_ON_FD_3
switch ON field 3
format size correction > 24x24cm serial changer chamber
EWBX13:7-EWB100X1:A22
0V/+26V low active

SW_PR_FL_1
switch preparation or fluoro 1
contact to drive an external prep or fluoro indication lamp
EWBX22:2-EWB100X1:C13
partner of COM_EX_CD

SW_SF_CF_1
switch side field to central field bucky measuring chamber (WA + WB)
EWAX11:1-EWA100X1:A18
EWBX11:1-EWB100X1:A18
cassettes < 23cm
0V/+26V low active

SW_SF_CF_2
switch side field to central field bucky measuring chamber 2 (WA only)
EWAX12:1-EWA100X1:A20
cassettes < 23cm
0V/+26V low active

SW_TO_1
switch tomography 1 ready
EWAX11:5-EWA100X1:A19
part of: tomo ready contact
0V/+26V low active

SW_TO_2
switch tomography 2 ready
EWAX12:5-EWA100X1:C20
part of: tomo ready contact
0V/+26V low active

SW_UN_EX
radiation indication
EZ150X1:A29-EZX1:4-EWGX1:4
partner of CM_SW, potential free contact

SW_UN_EX_1
radiation indication
(EWGX1:4)=EWGX2:4
partner of CM_SW, potential free contact

SW_UN_EX_1
switch radiation indication 1
contact to drive an external X-ray indication lamp
EWBX22:4-EWB100X1:C14
partner of COM_EX_CD

SW_UN_EX_2
radiation indication
(EWGX1:4)=EWGX3:4
partner of CM_SW, potential free contact

SW_XG_RD_1
switch generator ready 1
contact to drive an external ready indication lamp
EWBX22:1-EWB100X1:A13
partner of COM_EX_CD

SW_WN_FL_1
switch warning fluoro 1
contact to drive an external fluoro warning indication lamp (> 5 minutes)
EWBX22:3-EWB100X1:A14
partner of COM_EX_CD

TB_2/
tube 2 selected
EZ130X1:A13-EZX11:2-EWGX11:2
0V/15V, low active

TB_2_RT
tube 2 return signal, tube selection check
EWGX11:3-EZX11:3-EZ130X1:A10
0V/5V, low active

TB_3/
tube 3 selected
EZ130X1:C13-EZX11:5-EWGX11:5-EWGX12:2
0V/15V, low active

TB_3_RT
tube 3 return signal, tube selection check
E2WGX11:3-E1WGX12:3-E1WGX11:6-EZX11:6-EZ130X1:C10
0V/5V, low active

TB_CU_FR_NG
tube current frequency negative
EG100X14:14-EZX35:14-EZ119X1:BZ32
-14V against ground, frequency: 1 kHz = 2mA, 0 ... 1500mA 500kHz/A
differential signal with TB_CU_FR_PO

TB_CU_FR_PO
tube current frequency positive
EG100X16:6-EZX35:6-EZ119X1:BZ30
-14V against ground, frequency: 1 kHz = 2mA, 0 ... 1500mA 500kHz/A
differential signal with TB_CU_FR_NG

TH_OL
tube housing overload
NTC temperature measurement in tube housing (not yet available)
EZ130X1:A12-EZX3:6-EWGX7:6-EWGX8:6-EWGX9:6
backpanel 4512 108 05983
EZ130X1:A12-EZX3:3-EWGX7:3-EWGX8:3-EWGX9:3
backpanels 4512 108 05984 + 4512 108 09361/2
4.4V ... 1.5V = 20 ... 100 degrees C
partner of CM_TH

TH_OL_SW/
tube housing overload switch
EZ130X1:A11-EZX3:3-EWGX7:3-EWGX8:3-EWGX9:3
backpanel 4512 108 05983
EZ130X1:A11-EZX3:6-EWGX7:6-EWGX8:6-EWGX9:6
backpanels 4512 108 05984 + 4512 108 09361/2
0V ... 1.7V = short circuit, 1.7V ... 3.3V = closed, >3.3V open
partner of CM_TH_SW

TOMO_PG
tomo mode programmed
EWA100X1:A17-EWAX22:9
common line for tomo trajectory selection TO_PG_1 ... 8 to stand, potential free

---

TO_PG_1
tomo program 1
EWA100X1:A13-EWAX22:1
tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_2
tomo program 2
EWA100X1:C13-EWAX22:2
tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_3
tomo program 3
EWA100X1:A14-EWAX22:3
tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_4
tomo program 4
EWA100X1:C14-EWAX22:4
tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_5
tomo program 5
EWA100X1:A15-EWAX22:5
tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_6
tomo program 6
EWA100X1:C15-EWAX22:6
tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_7
tomo program 7
EWA100X1:A16-EWAX22:7
tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_8
tomo program 8
EWA100X1:C16-EWAX22:8
tomo trajectory selection, potential free contact with TOMO_PG

TO_PG_SL
tomo program selected
EWA100X1:C17-EWAX22:10
tomo APR selected = closed, overriding = open, potential free contact with TOMO_PG

TP_HT_GND
temperature high tension tank ground
EZ130X1:A19-EZX35:12-EG100X14:4
partner of TP_HT_SG

TP_HT_SG
temperature signal high tension tank
NTC in high tension tank oil
EG100X14:12-EZX35:4-EZ130X1:C19
4.4V ... 1.5V = 20 ... 100°C
+25 _C(12kW) ... +100 _C(950W)
partner of TP_HT_GND

V15C
(S_CAN_PO) backpanel 4512 108 05983 only
system CAN supply
EZX42:9-EZX43:9-EZX44:4-EZ139X1:A17
Vcan
part of: system CAN

V15S
signal bus supply backpanel 4512 108 05983 only
EZX23:13/25-EZX44:5-EZX45:7-EZ130X1:AC6-EWAX51:7-EWAX52:7-EWA100X2:AC27
+15V Vsgn
part of: signal bus

VO_CR_IF_0
density voltage correction II format dependent 10”
EWBX13:3-EWB100X1:C22
0V/+26V low active

VO_CR_IF_1
density voltage correction II format dependent 5” / 6”
EWBX13:9-EWB100X1:A23

X_ACT/
X–ray active signal bus
EZ139X1:A5-EZX23:5-EZX45:6-EWAX51:6-EWAX52:6-EWA100X2:C24-EWBX51:6-EWBX52:6
-EWB100X2:C24
driven by CU if X_ACT_S/ was sent from FU-kV or during fluoro, old: EXON signal
measuring point: EZX86
part of: signal bus
0V/+15V

X_ACT_S/
X–ray active signal
kV > 75% nominal value driven by FU-kV or fluoroscopy high tension on driven by CU
EZ119X2:A8-EZ130X2:A8-EZ139X2:A8-EZ150X2:A8-EZX52:5-EZX77
0V/+5V
measuring point EZX77
part of: XS/XRG bus, controls X_ACT/ status

XG_RD_EX_1
X–ray generator ready for exposure request
grid / sync release signal
EWA100X1:C3-EWAX1:2
EWAB100X1:C3-EWBX1:2
0V/+26V low active
partner of RQ_XG_EX for grid sync (20-21)

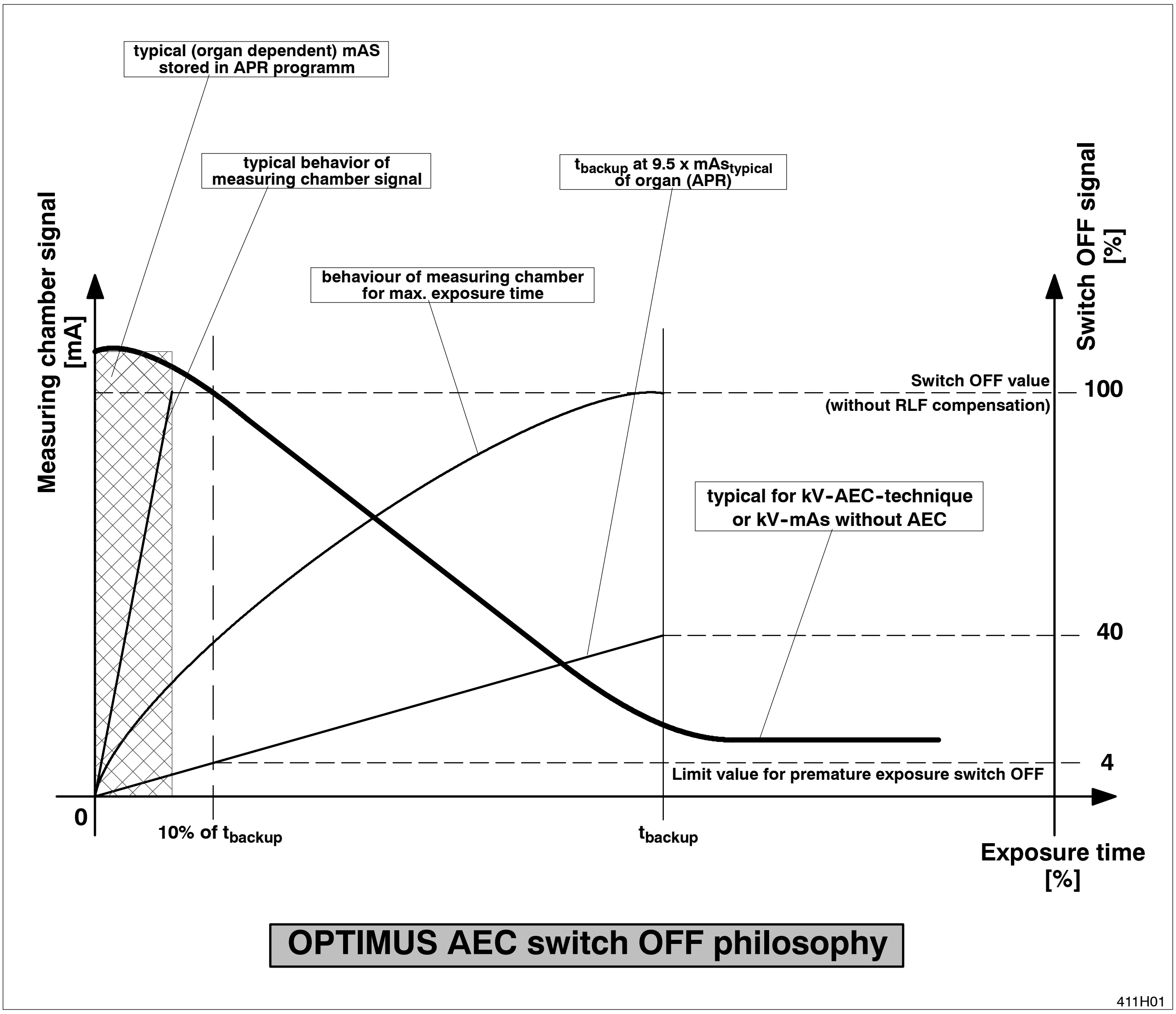
XG_RD_EX_2
X–ray generator ready for exposure request
grid / sync release signal
EWA100X1:A6-EWAX2:2
EWB100X1:A6-EWBX2:2
0V/+26V low active
partner of RQ_XG_EX for grid sync (20-21)

XG_RD_EX_3
X–ray generator ready for exposure request
grid / sync release signal
EWA100X1:A8-EWAX3:2
EWB100X1:A8-EWBX3:2
0V/+26V low active
partner of RQ_XG_EX for grid sync (20-21)

XG_RD_EX_4
X–ray generator ready for exposure request
grid / sync release signal
EWA100X1:A10-EWAX4:2
EWB100X1:A10-EWBX4:2
0V/+26V low active
partner of RQ_XG_EX for grid sync (20-21)

13. Optimus AEC switch-OFF philosophy

For explanation the following figure:



Every APR using the AEC technique as the preferred technique must have mAs, mA-s or mAs-s parameters in the background. These should almost match the typical organ-related dose to the selected film/screen combination.

A film which got at least 40% of the desired density can be used for diagnosis.

If the AEC exposure starts now two supervisions are active with the aim of not giving unnecessary dose (or simply a proper AEC exposure is obtained):

1. The organ-dependent background mAs value is multiplied with 9.5. If the exposure is not finished at 9.5 x mAs_{backup} the generator stops. One must expect that something went wrong if the exposure exceeded 9.5 times the typical mAs value. This exposure has not been cut OFF by the supervision 2.
2. With the 9.5 x mAs_{backup} a kV and filament load dependent backup time is calculated by DRC (dose rate control). At 10% of this time value DRC checks if at least 4% of the desired dose has been detected by the measuring chamber.
   If the 4% limit does not increase, the exposure switches OFF. The minimum of 40% density cannot be obtained during the remaining backup time.

This 4% dose detection is automatically OFF, if the film/screen combination is too sensitive (> 400 speed systems). The 4% value is too small to be reliable for a measurement.

With overriding the supervision switches OFF.

How to test the limits of 600mAs or 4000ms in AEC technique

One has to bypass the 4% detection and the background mAs value must be high enough to reach 600mAs. The 4% detection can be switched OFF with modifying the value dose of FSC [μGy]:

- Type in a value of 1 (which is equal to a 1000 speed system) in the dose of FSC data field of any of the programmed film/screen combinations.
- Now select any APR and increase the background mAs value to 100mAs.
- Close the collimator or cover the chamber with lead.

The AEC exposure stops at a value which is always below 600mAs, a typical limit is 588mAs.

With the modified parameters the 4000ms test can be carried out:

- Select the modified APR on the control desk and go to <SELECT APR> and <CHANGE APR> with the PC.
- Reduce the Ie max factor to 5% and transmit the APR screen.
- Select the APR button again, the modified data are active now.
- Select the small focal spot.
- Switch an AEC exposure. It should last 4000ms.
- Change all modifications back to normal.

The supervision can be switched ON or OFF, programming path:

XRGSCOPE – Optimus (XRG90) – Programming – Dose Rate Control – AMPLIMAT – Fault Exposure Detection – AEC or TDC – ON/OFF

(Explanation see documentation.)

Precalculation tables of the exposure which is actually displayed on the control desk can be seen on the PC under:

XRGSCOPE – Optimus (XRG90) – Faultfind – X-Ray Log – Dose Rate Control Logging – etc.

14. AEC fault exposure detection strategy

The major intention of having a fault exposure detection is to prevent unnecessary radiation for the patient in case of a malfunction of the installation or a mistake when handling the X-ray equipment.

AEC fault exposure detection = ON

The factors determining whether the 4% dose value at 10% of the APR backup time are checked are

- the 10% backup time value > 10ms
- the expected 4% density voltage value > 20mV

In case of APR100 the check could be performed because the density voltage values are high enough.

The density voltage at 10% of the backup time would be too small to be measured for APR800, therefore the exposure continues up to the 9.5 x APR mAs value. The exposure finally terminates at 570mAs if the APR mAs value is ≥ 60mAs.

With APR100* the exposure terminates at 10% of the max backup time, which is 4000ms for all AEC exposures after overriding of any APR parameters. (The 600mAs limit does not switch OFF the exposure, 1500mA emission current is not available).

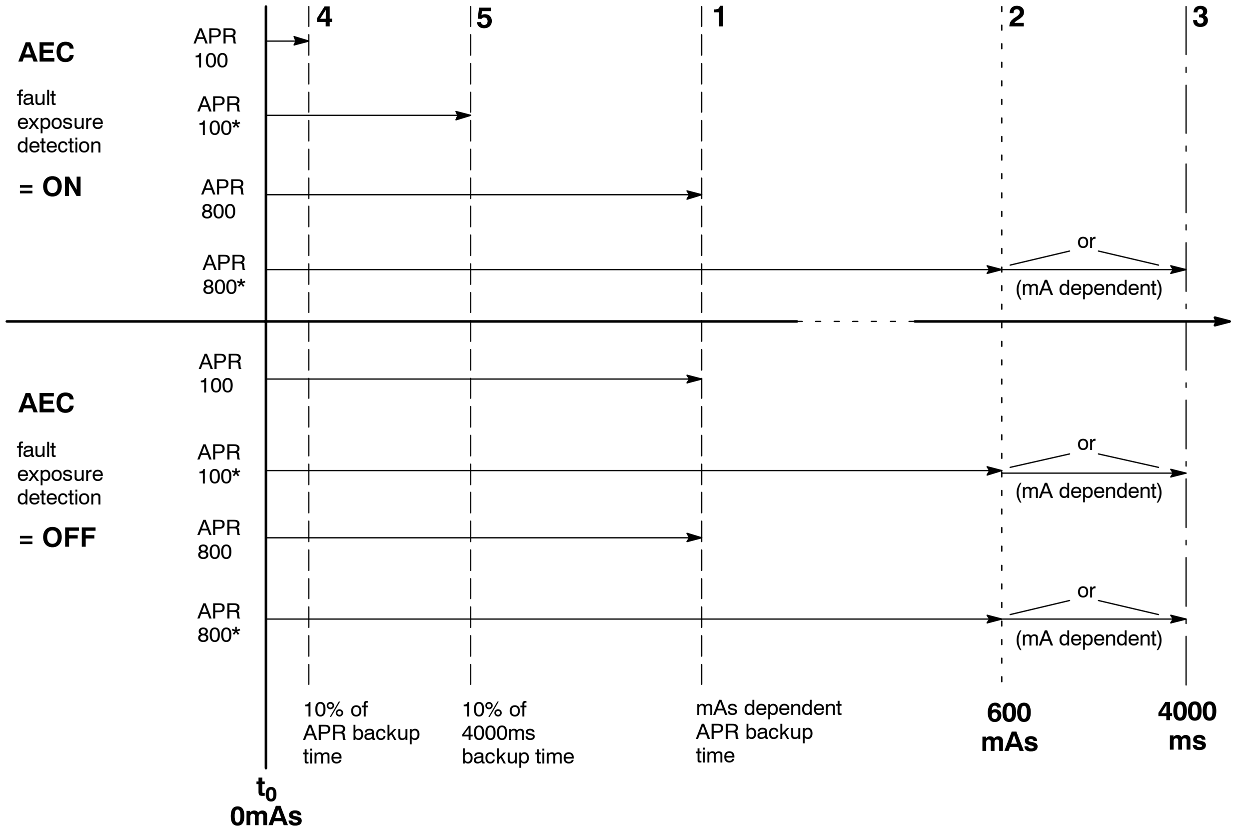
With APR800* the exposure terminates either at 600mAs or 4000ms, depending on which of the limits is reached first.

AEC fault exposure detection = OFF

APR100 and APR800 exposures have the same termination point at 9.5 x APR mAs. The exposure finally terminates at 570mAs, if the APR mAs value is ≥ 60mAs.

APR100* and APR800* exposures terminate either at 600mAs or at 4000ms, depending on which of the limits is reached first.

For explanations see figure and list of terms on following 2 pages.



AEC fault exposure detection strategy

413H01

List of terms

AEC = Automatic Exposure Control

APR100 = APR program with a less sensible film/screen combination of 100 speed, original parameters as programmed.

APR100* = as same as APR100, but parameter(s) modified on the control desk (overriding).

APR800 = APR program with a very sensible film/screen combination of 800 speed, original parameters as programmed.

APR800* = as same as APR800, but parameter(s) modified on the control desk (overriding).

600mAs = programmed mAs limit for AEC exposures (can be changed, must comply with the local regulations).

4000ms = max time limit of AEC exposures (cannot be changed).

1 = point of the mAs dependent APR backup time, which is calculated from the 9.5 x (typical) organ mAs value of the APR
2 = max mAs limit for AEC exposures (can be changed)
3 = max exposure time limit of 4000ms (cannot be changed)
4 = 10% (of the APR backup) time point
5 = 10% backup time point of the max exposure time limit (4000ms) = always 400ms

To explain the difference in switching the fault exposure detection **ON** or **OFF**, a very sensible (800 speed system) and a less sensible (100 speed system) film/screen combination have been chosen.

15. Explanations on programming the generator

- Select menu:
  OPTIMUS\ PROGRAM\ DOSE RATE CONTROL\ **CONT ...**

scantime_TV [ms]: [20.000] = default 20ms
20ms must be programmed for all TV chains with a scantime ≤ 20ms.

- In case a TV chain has a longer scantime program the actual scantime value:

  scantime_TV [ms] = [20.000] for scantime of TV chain ≤ 20ms
  or
  scantime_TV [ms] = [xx.xxx] for scantime of TV chain = xx.xxx ms > 20ms

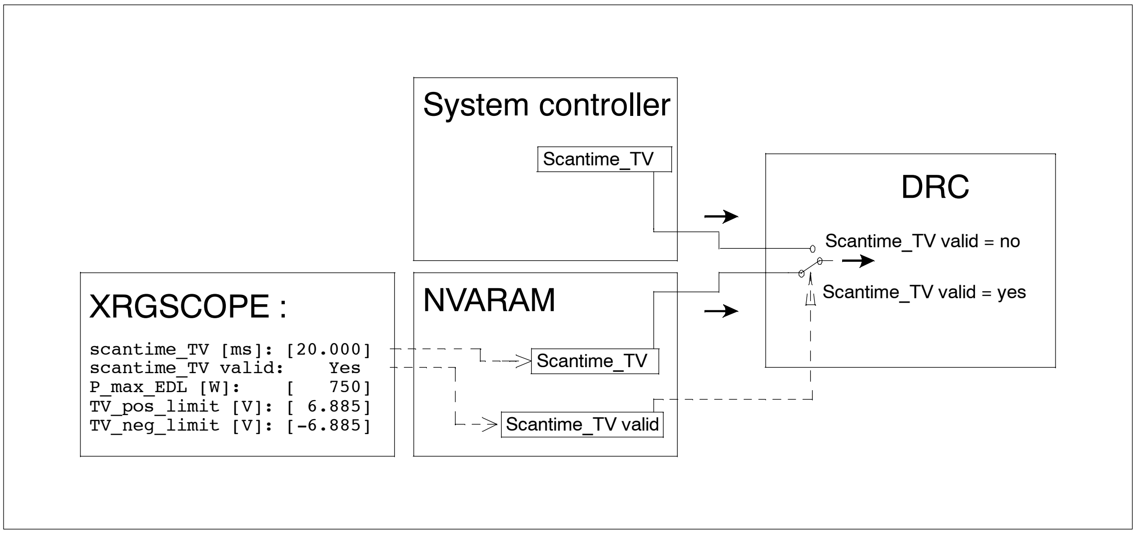
scantime_TV valid: YES (default)

With **YES**, the programmed variable scantime_TV [ms] is used for the control in FU Dose Rate Control (DRC).

At the moment only this value is possible.

With **NO**, the programmed variable scantime_TV [ms] is **not** used for the control in FU Dose Rate Control (DRC).
The variable is delivered by the system controller.
This version is a future option. At the moment it is not applicable.

See figure explaining the program settings below:



16. Printed-circuit boards

Low-voltage power supply: EZ102

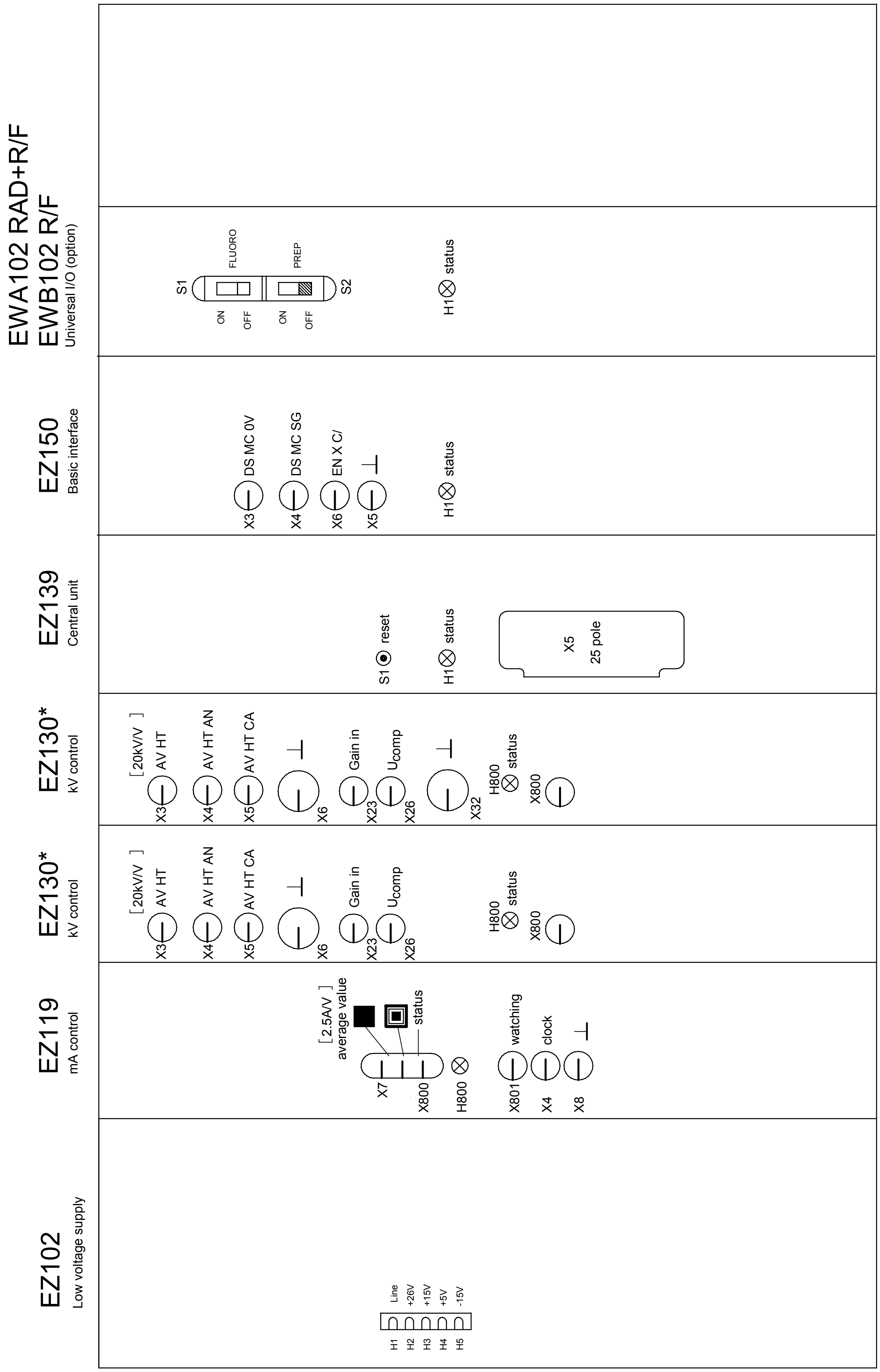
Also see Z1–2.3 ”Low-voltage power supply”.

LEDs H2 to H5 indicate whether the supply voltages are present.

The low-voltage power supplies of PCB EZ102 are short circuit proof. Therefore it is most likely that in case one of the LEDs grows dark one of the external consumers and not the PCB itself is the cause of the error.

It is recommended that one after the other all consumers be disconnected from the respective power supply until the LED is illuminated again.

The last consumer that was removed has probably caused the short-circuit.



* EZ130 dependent on SW Rel.-level

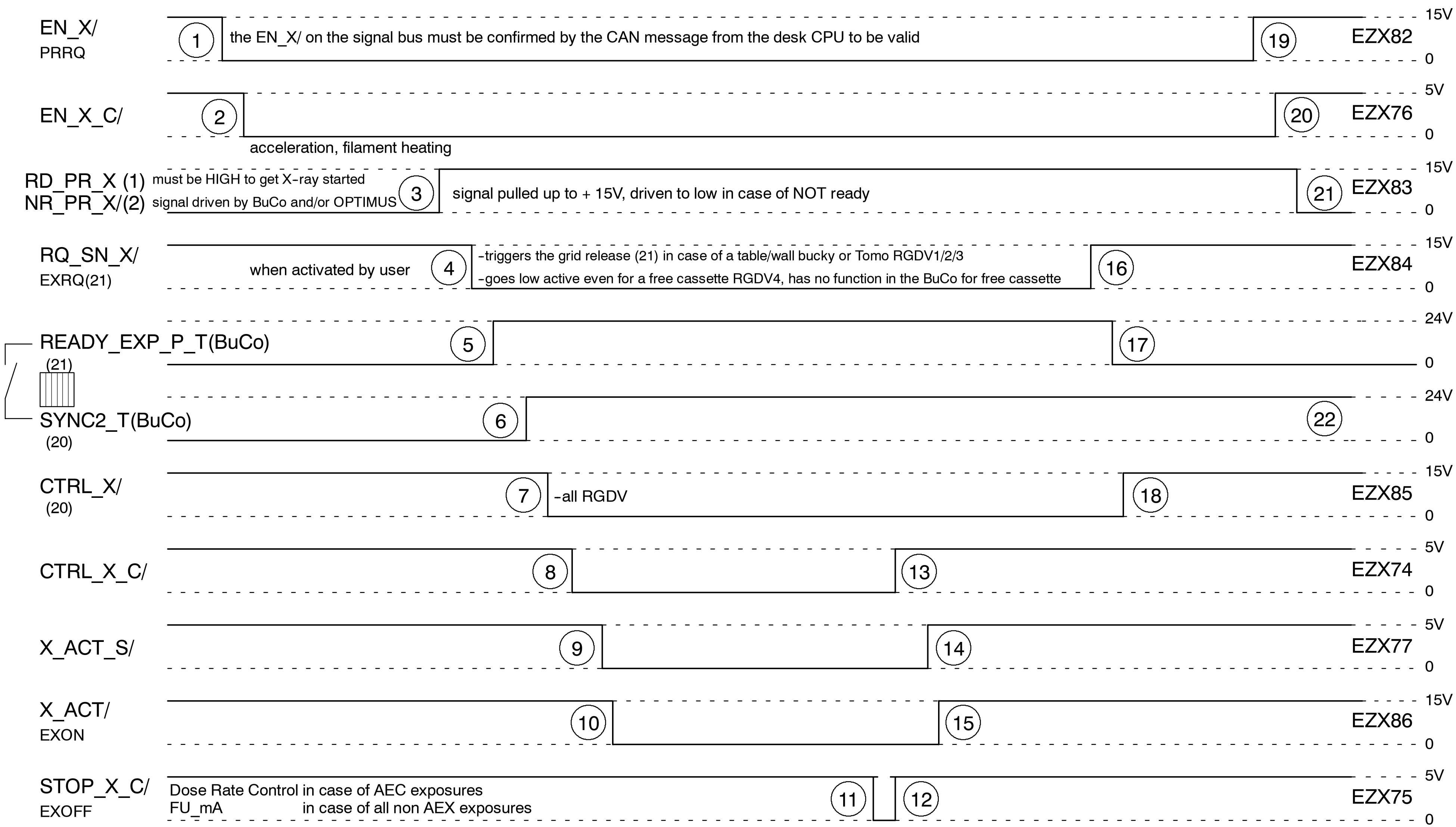
A2/A4 01-10-24 Schr.

Central rack,
service aid

A4 97-12-18 Sie./Re

optimus_r_f_3z-10

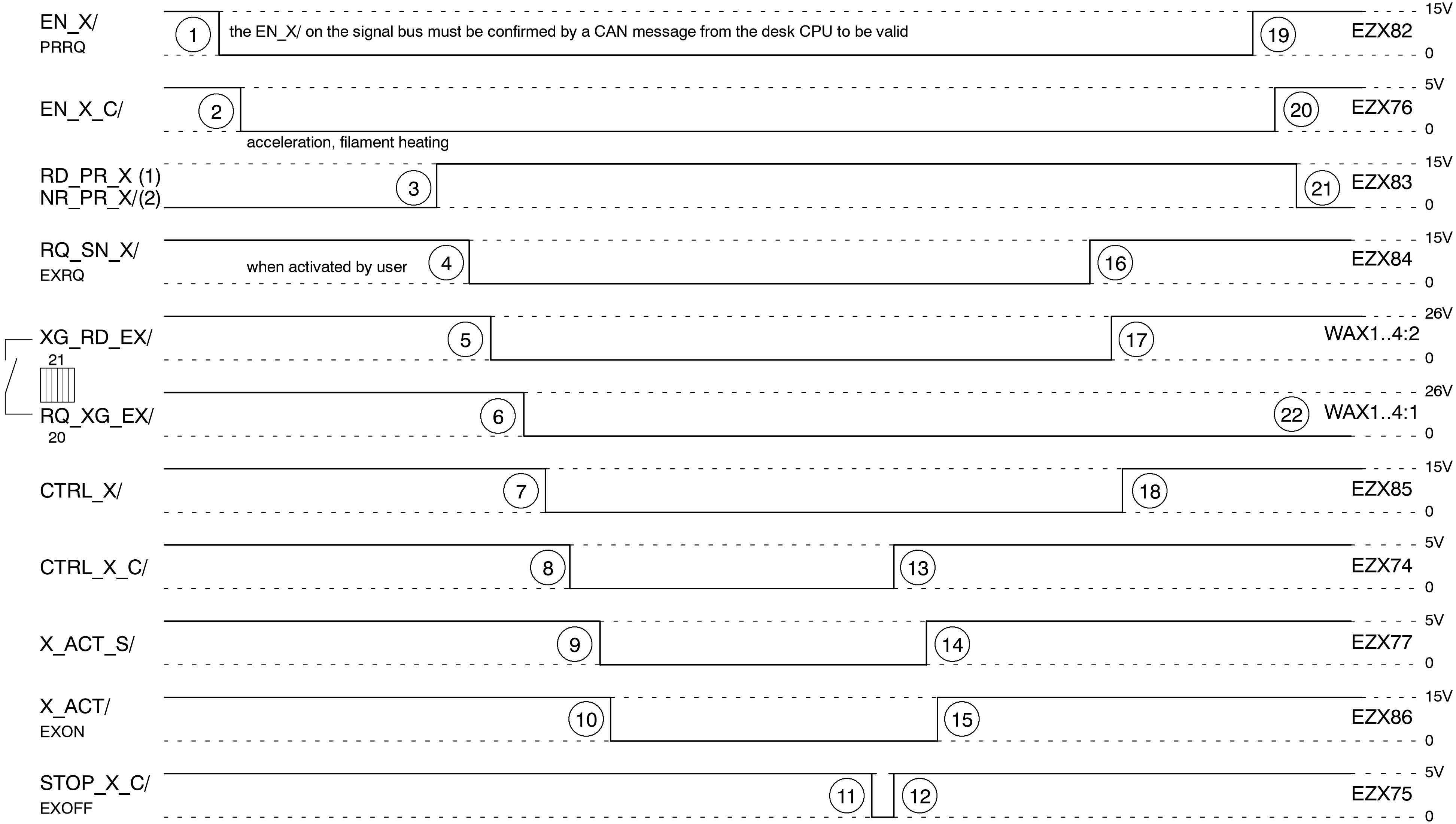
Signals during an exposure released from the desk handswitch with Bucky Controller (signal bus EZX23)



(1)(2)with backpanel 4512 108 05983 and CU 4512 108 0902x
(2) with backpanel 4512 108 05984 and CU 4512 108 0902x
(2) with backpanel 4512 108 0936x and CU 4512 108 0902x

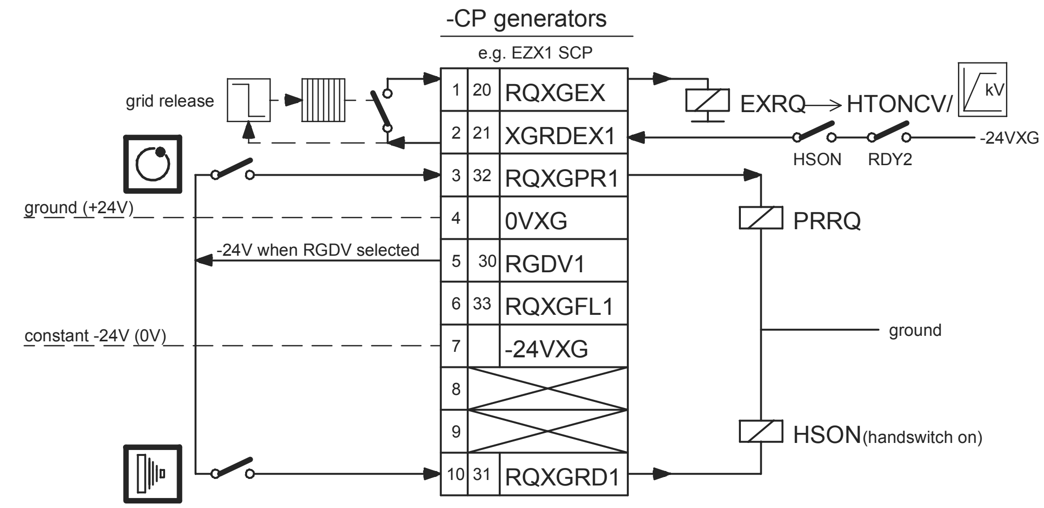
measuring points EZX8x only
backpanel > = 4512 108 05984
and 4512 108 0936x

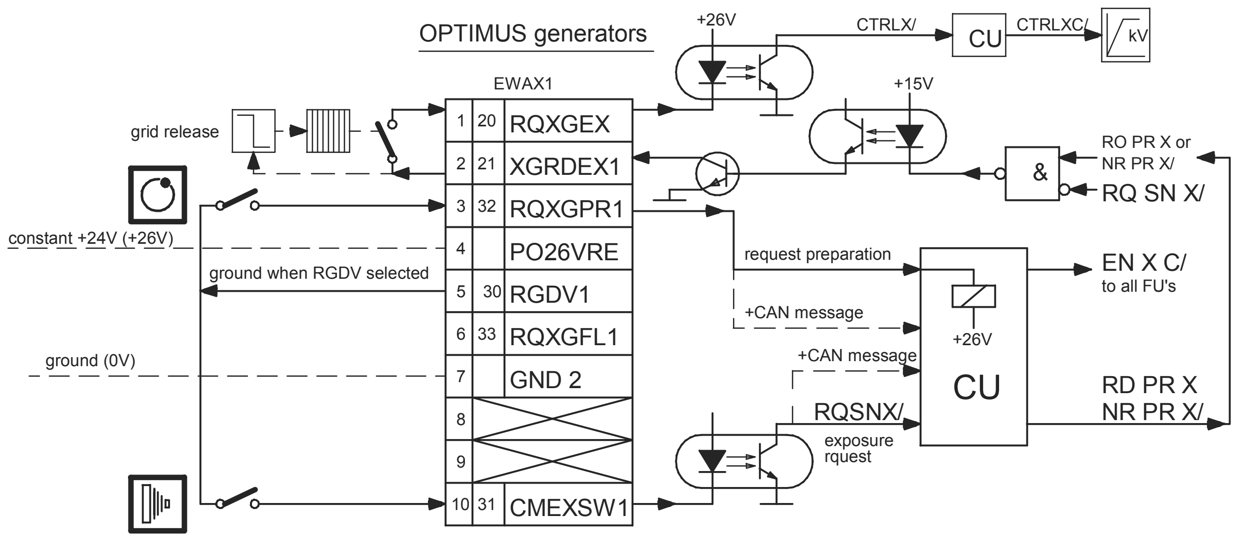
Signals during an exposure released from the desk handswitch (with adapter for 4 aux. units WA/WB)



(1) with backpanel 4512 108 05983 and CU 4512 108 0582x
(2) with backpanel 4512 108 05984 and CU 4512 108 0902x
(2) with backpanel 4512 108 0936x and CU 4512 108 0902x

measuring points EZX8x only
backpanel > = 4512 108 05984
and 4512 108 0936x





A3/A4 97-09-08 Schr.

Comparison release decades
-CP generators<- ->OPTIMUS

Commands given via release decades
not desk handswitch

REPLACEMENT

TEXT

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1. Traceable items

Trace items are:

1. Generator cabinet
2. H.V. tank
3. Operating desk

They are labelled as follows:

- type number
- serial number (s/n)
- manufacturer
- HHS certification
- code number

combined label

With new traceable items for replacement a separate label is delivered.
This must be affixed to the label bracket on the top left corner of the generator cabinet.
See drawing 2Z-10 “Labelling”.

The new type number, code number and serial number must be entered on the master card for the generator.

Please, send a copy of the corrected master card as FAX to:

Philips Medical Systems
DMC Hamburg, Germany
Department: GEN-OPERATION
FAX No.: +49 40 5078 1247

1.1. Generator cabinet

The generator cabinet as a traceable item is labelled by a 6-digit serial number:

Example:

s/n **01 1234**

Meaning:

01 = year of manufacture, e.g. 20**01**
1234 = consecutive number

1.2. H.V. tank

H.V. tanks have a 7-digit serial number which has the following meaning:

Example:

s/n **01 04 123**

Meaning:

01 = year of manufacture, e.g. 20**01**
04 = power class, e.g. 65/80kW, 2 tubes
123 = consecutive number

Power classes:

01 = 50kW, 1 tube
02 = 50kW, 2 tubes
03 = 65/80kW, 1 tube
04 = 65/80kW, 2 tubes

Caution!
An exchange of a H.V. tank requires a new alignment of “Function Unit kV”.
For alignment work refer to chapter 4 in this section.

1.3. Operating desk

The operating desk is labelled by a 8-digit serial number:

Example:

s/n **01 02 1234**

Meaning:

01 = year of manufacture, e.g. 20**01**
02 = internal number of subcontractor
1234 = consecutive number

2. Printed-circuit boards

PCB	HW programming	SW programming via XRGSCOPE	Tube adaptation	Remarks
EZ backpanel	• see Z2-5.1/.2/.3			To attend to: X4 emergency OFF X10 EN_X/ X42 system CAN termination X44 function programming plug X45 generator CAN termination X52 shall not be present
EZ102 low voltage supply				
EZ119 mA control	• exchange PROM or insert new PROM • set battery jumper to ON • see 5Z-1	• load tube data set(s)	all tubes	Bucky TH, Digital Diagnost, Thoravision systems: • Set RGDV according to adaptation. See section 2, chapter 8.3.2.
EZ130 kV control	• exchange PROM or insert new PROM • see 5Z-1			• Carry out alignment of ”Function Unit kV”.
EZ139 CU	• exchange BOOT PROM or insert new PROM • see 5Z-1	• set date and time • restore CU complete or start programming from beginning		• Carry out alignment of ”Function Unit kV” if no CU complete files are present.
EZ150 basic interface	• see 5Z-1	• check AMPLIMAT sensitivity according to jumper W4		• Set jumpers W2 + W3 according to required chamber supply. • Set jumper W4 according to programmed AMPLIMAT sensitivity.
EN100 power ON circuit				
EG100 measuring circuit				Exchange is not allowed. Requires alignment which is not possible in the field. • Exchange the whole tank.

PCB	HW programming	SW programming via XRGSCOPE	Tube adaptation	Remarks
EWA 1WA / 2WA bucky-tomo backpanel EWB R/F adapter backpanel	• Address W1...W3 • Supply + ground W11...W13 • see Z1-15.1			
WA102 universal I/O	• see 5Z-2			Can be used in: WA / 1WA / 2WA / WB / 1WB
EY100 rotor control high speed	• swap PROM or insert new PROM • see 5Z-2			
EYA100 rotor control low speed				
C300 desk CPU	• swap PROM or insert new PROM • see 5Z-2			

3. Exchange of firmware or update to release 3.5:

NC: 9890 000 0251x Firmware OPTIMUS Rel. 3.5
4512 114 2083x Central Unit

The CU firmware is no longer available as an EPROM (EZ139 D4/D5).

It must be loaded from the PC into the respective flash PROMs.

For loading firmware release 3.5 the following firmware levels must be present in the generator:

- CU-Boot : ≥ 4512 113 2073x
- FU-kV : ≥ 4512 113 2013x OPTIMUS RAD
- FU-kV : ≥ 4512 113 2621x OPTIMUS R/F
- FU-mA : ≥ 4512 113 2021x
- FU-CIE : ≥ 4512 113 2031x
- FU-HI : ≥ 4512 113 2052x
- FU-Adap : ≥ 4512 113 2061x
- FU-RoCo : ≥ 4512 113 2232x

Caution!
Before changing the release, save all configuration data of the generator!
Refer to chapter 3.2.1 “Backup of all configuration data”.

3.1. PC and generator settings to avoid problems during uploading of CU complete files

Optimus R/F release 3.x CMOS data are uploaded in one string without handshake.

Any kind of interruption can cause the loading process to fail.

Problems occur mainly during the download to the PC.

A download file which is not complete cannot be used as a safety backup file.

3.1.1. Preparation of the service PC to guarantee a safe loading process

Start XRGSCOPE always from DOS if possible.

In case of any WINDOWS version:

- Switch OFF all screensavers.
- Do not run other programs.
- Do not insert any CD in the drive.

Any kind of power management of the PC hardware (BIOS) as well as the windows power management should be switched OFF.
If the PC is connected to mains power some of these might be automatically OFF.

3.1.2. Preparation of the generator

Preparation of generators without a CAN interface:

- Switch OFF the generator.

Preparation of generators which are connected via a CAN interface:

- BuckyDiagnost TH and TH2
- DigitalDiagnost
- Thoravision
- EasyDiagnost with bucky unit

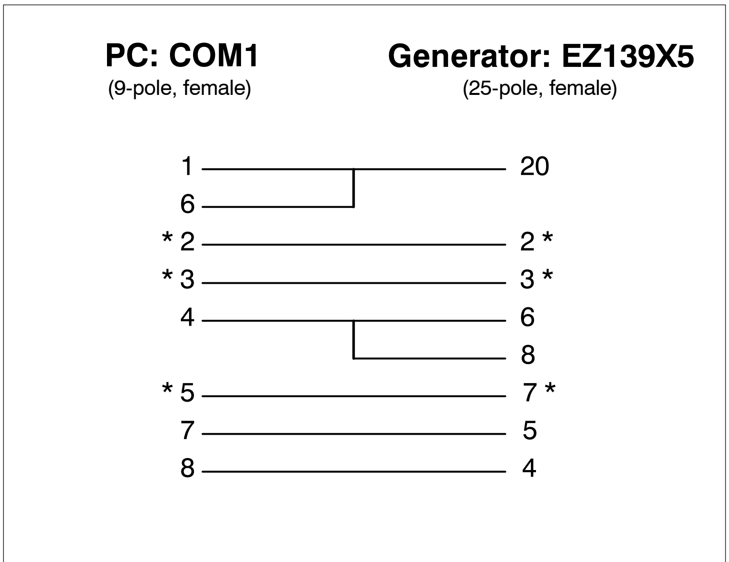
* Switch OFF the generator.
* Disconnect the following plugs:

System	**Connector**		
	EZX23 **signal bus**	**EZX42 or EZX42-1 system CAN**	**EZX43 or EZX43-1 system CAN**
BukyDiagnost TH / TH2	X		X
DigitalDiagnost	X	X	X
Thoravision	X	X	X
EasyDiagnost with Bucky unit	X	X	X

3.2. Backup / Installation procedure

- Provide the service PC with the hardware key and switch it ON.
  The hardware key provides access to special program settings and to menu ***”Faultfind”.***
  Standard programming is possible without a hardware key.

- Connect the PC to X5 on EZ139 CENTRAL UNIT CU via a serial data cable:
  (A 5m long data cable can be ordered via 12NC: 4512 130 56931)



* = sufficient for communication RAD / RF

- Insert the floppy disks containing the self-unpacking exe-files of the firmware in the disk drive of the PC:
  - OMA : 4512 116 022xx
  - OMB : 4512 116 023xx

  For unpacking on the harddisk of the PC about 5MB are needed.

- Generate a directory e.g. [C:\OPT_R_35] on the PC by typing **<md C:\OPT_R_35>** or use WIN commands.

- Copy the firmware from both floppy disks to the PC into the same directory C:\OPT_R_35 by typing **<copy A:*.* C:\OPT_R_35>** or use WIN commands.

- Start unpacking the programs by typing **<OMAxxxxx.exe>** and **<OMBxxxxx.exe>** or doubleclick on **<*.exe>** –files.
  The programs unpack all files needed for the update of the firmware and the newest service tools.

- After unpacking [OMAxxxxx.exe] and [OMBxxxxx.exe] can be deleted on the harddisk by typing **<del OMAxxxxx.exe>** and **<del OMBxxxxx.exe>**.

- For the current contents [of OMA/OMBxxxxx.exe] read [OMA/OMBxxxxx.txt] on the floppy disks.

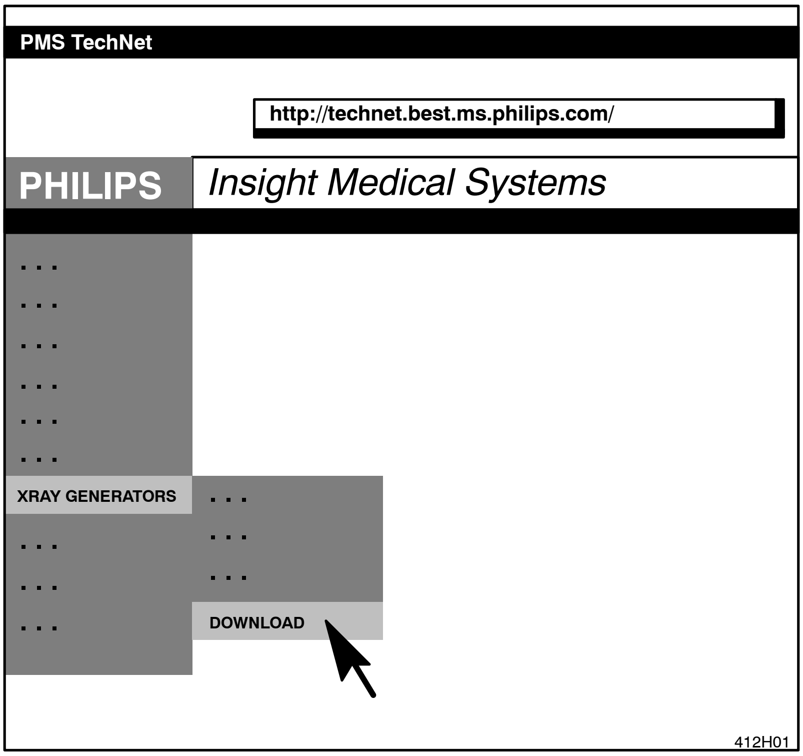
- For further installation of the firmware in the generator read README.txt.

General information:

- Button **<F1>**	**<help>**	Call help / cancel help.
- Button **<F2>**	**<transmit>**	Store screen contents / data set in the generator ==> transmit to generator.
- Button **<F3>**	**<save>**	Store data screen on disk. For an open data screen the path desired can be selected.
- Button **<F4>**	**<load>**	Load data set from disk. The desired path can be selected.
- Button **<ESC>**		Commands one step back. Can be used repeatedly.
- Fields with ↓		Select the possible range of values by pushing **<RETURN>**. The data are specified by the generator as fixed values.
- Fields with **[...]**		Input of data via the keyboard.

Error numbers which appear at the beginning of the programming procedure must be erased from the screen by pushing the **<RETURN>** key.

Current data files, for instance, for online help, tube types, APR programming are available in the PHILIPS-Intranet. Use path ***http://technet.best.ms.philips.com/*** and pull down menu as shown below.



If you call the installation program with **<xrgscope ?>** the possible starting parameters for the service program are listed.

3.2.1. Backup of all configuration data

- Switch ON the generator.

To save the configuration data use the CONFIGURATION BACKUP disk supplied.

- Save the complete SW programming of the generator on the floppy disk by using the menu:
  ACCEPT/ BACKUP/ **CU complete**

  A disk space of 700kByte is required.
  It takes about 8min to save the data to the disk.

  The default backup name:
  Backup File Name: **CUBACKUP.TDL**
  The name can be changed into any other filename.
  The path (harddisk) is automatically taken into account.
  It is also possible to type:
  A:**"filename"** <RETURN>
  to load the backup files directly to the floppy disk.

3.2.2. Loading the new firmware into the generator

- Switch OFF the generator.
- When installing the firmware

  from COM 1 enter FLASH1.BAT
  from COM 2 enter FLASH2.BAT
  "Attempting link" appears on the screen.

- Switch ON the generator.

  Depending on the type of PC data transmission takes 15 ... 30min.
  During this process all red LEDs of the function unit are blinking.

  Caution!
  When the data transmission to the generator is completed, the scope program is still active. This is unfortunately not displayed on the screen. For several minutes, while the screen is blank, the flash PROMs are loaded into the generator. This process must under no circumstances be disturbed! At the end of this sensible procedure "Flash loaded o.k." appears on the screen. Only now the scope program can be terminated.

- Reset the generator.

4. Replacement of parts of ”Function Unit kV”

In case one of the following assemblies:

- PCB kV-control 3 / 4 (EZ130)
- Converter (EQ)
- H.V. tank (EG)
- PCB Central unit (EZ139)

of ”Function Unit kV” has been exchanged, the alignment of the ”Function Unit kV” must be repeated.

4.1. General information

The actual value of the set kV must be attained at least after 2ms. At kV rise phase there must be neither kV break-in nor a kV overshoot.

The Factor Duty Cycle is based on an adapted tube and determines at local mains voltage and mains resistance conditions:

- the kV rise phase
- the kV behavior during the exposure in falling load technique

The Factor Duty Cycle is stored in the memory of PCB CU EZ139. If the CU has to be replaced the CU complete backup can be reloaded (with the actual factor) to the NVRAM memory or the Factor Duty Cycle must be re-aligned. Refer to figure 1:

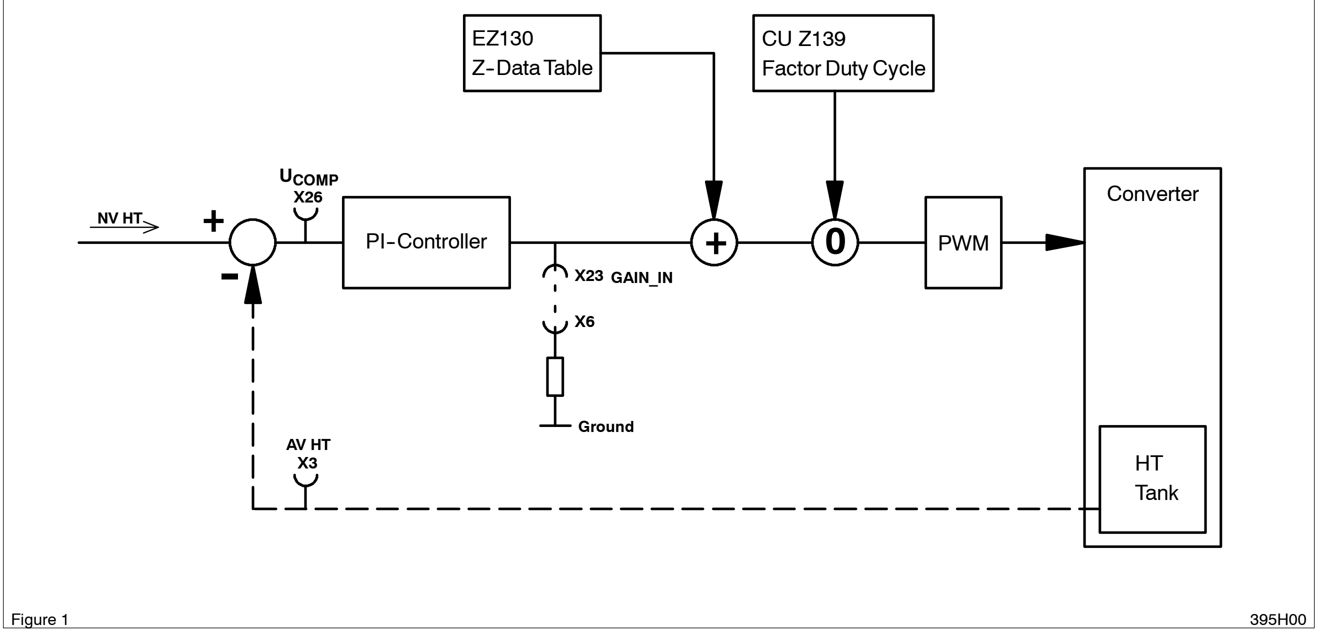


Figure 1 395H00

During alignment this Factor Duty Cycle must be entered via XRGSCOPE. The influence of this factor as a correction value for the Z-Data Table is monitored as the U_{COMP} signal, since the PI-Controller is deactivated by the grounded *GAIN_IN* signal.

4.2. Connecting and setting the scope

For connections see figure 2:

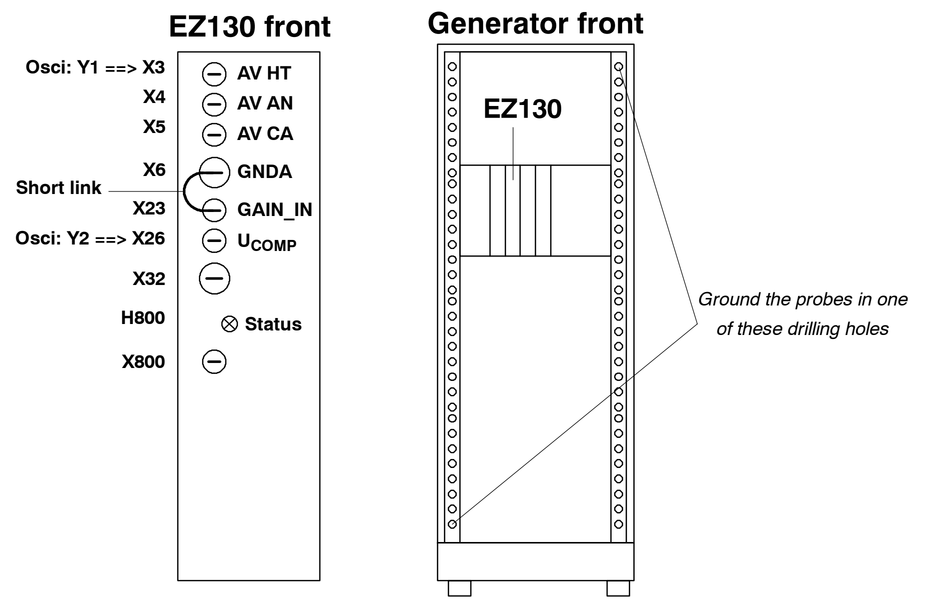


Figure 2 396H00

Channel 1 = EZ130 X3 ---> *AV HT* ---> 20kV/V ---> 1V/div --> Zero-line at bottom of screen
Probe GND = one of the drilling holes at the front cabinet chassis

Channel 2 = EZ130 X26 ---> U_{COMP} ---> 1V/div ---> Zero-line 2 div from bottom of screen
Probe GND = one of the drilling holes at the front cabinet chassis

Trigger	=	external (preferred)	--->	*CTRL_X_C/*	--->	backpanel EZX74 / negative slope
or	=	internal channel 1	--->	*AV HT*	--->	EZ130 X3 / positive slope at +3V
Probe GND	=	one of the drilling holes at the front cabinet chassis				

Time base = 5 or 10ms/div ---> trigger delay -1div

Note
A digital scope should not have any other ground connection than the ground of the 3 probes at the drilling holes at the front generator chassis.
A mains-driven scope must be isolated from earth potential, otherwise it might display artefacts.

4.3. Deactivating the kV controller

- Connect EZ130 X23 *GAIN_IN* and X6 *GNDA* with a short link (use a short wire).

Caution!

This alignment requires exposures with high kV.
Be sure the tube has been warmed up before.

4.4. Setting of exposure data

a) Set 141kV in case of

- 65/80kW
- the tube limit (of at least one tube) is 150kV perform this adjustment at the tube which has the highest kV limit programmed.

b) Set 125kV in case of

- 50kW

  and
- 65/80kW if the programmed application limit of the tube limit is 125kV.

Note

Any tube arcing during this adjustment requires the execution of the tube conditioning next as described in section 2 "INSTALLATION".
Disconnect the short link between X23 and X6.
Start over this adjustment from chapter 2.3 onwards if the tube conditioning was successful.

- Set kV and mA values according to the programmed tube limits:

a) 141kV:	200mA	at kV_4	(65/80kW)
b) 125kV:	100mA	at kV_3	(50kW)
	200mA	at kV_4	(65/80kW)

- Set exposure time: 40ms

4.5. Adjustment of the ”factor for duty cycle”

- Adjust the Factor Duty Cycle via service software XRGSCOPE by measuring U_{COMP} with the scope.
- Connect the service PC and start XRGSCOPE:
  XRGSCOPE
  SELECT UNIT ---> FU-kV ---> ADJUST ---> IGBT Pulse Width Correction ---> Factor Duty Cycle
- Set the starting value Factor Duty Cycle to **1.00**:

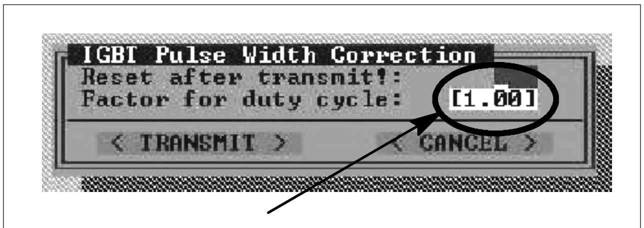
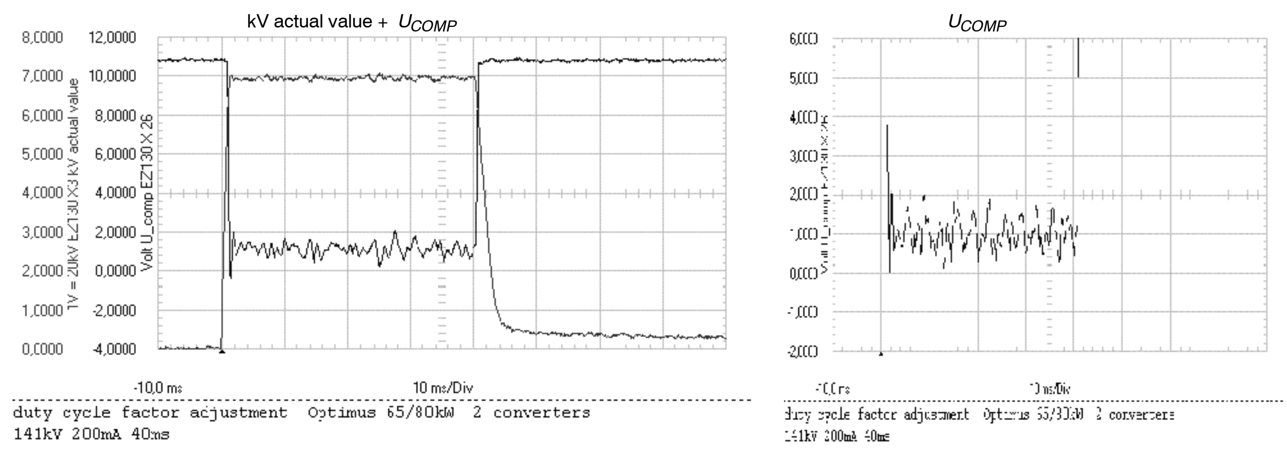


Figure 3 397H00

- If the U_{COMP} value does not match the requirements type in another Factor Duty Cycle value, <TRANSMIT> the screen and push the active RGDV button to get the new value validated.
- Switch an exposure.
  The values are measured in the stationary condition. The transient behavior at the beginning of the exposure is not taken into account.

Result: In standby the U_{COMP} value is at about +11V, during exposure the mean value U_{COMP} must be as given in table 1 or 2, refer to figure 4:



Oscillogram of a perfect alignment for 141kV

U_{COMP} for 141kV

Figure 4 401H00

a) 141kV setting (65/80kW only)

- Read the mean value of U_{COMP} for 141kV (see scope figure 4 or 5), correct the Factor Duty Cycle till U_{COMP} meets the required reference of +1V.

kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of *AV HT*	Factor Duty Cycle:	Date:
141kV	200mA	PCB kV_control 4:	+1V	±0.5V	138kV		

Table 1: Factor Duty Cycle, settings 141kV (150kV limit)

Example how to correct the Factor Duty Cycle:

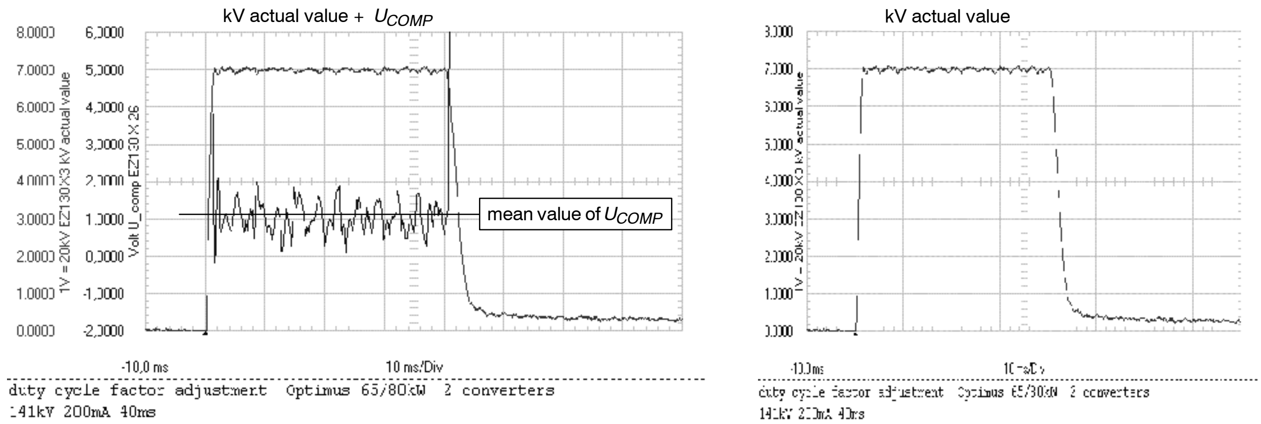
PCB kV_control 4:

- If the mean value of U_{COMP} is: > +1.5V **increase** the Factor Duty Cycle in steps of 0.01
  < +0.5V **decrease** the Factor Duty Cycle in steps of 0.01

- Check also the kV peak value *AV HT* (not the overshoot), it must be **138kV** for **141kV** setpoint. (see scope figure 5)

- Remove short link EZ130 X23 *GAIN_IN*.

- Record the findings in table1.



Optimus 80kW with 141kV, U_{COMP} = +1V

AV HT with overshoot

Figure 5 402H00

b) 125kV setting (50/65/80kW)

- Read the mean value of U_{COMP} for 125kV (in principle figure 4 or 5).
- Correct the Factor Duty Cycle till U_{COMP} meets the required reference of 0V.

kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of *AV HT*	Factor Duty Cycle:	Date:
125kV	100mA	PCB kV_control 3:	+0V	+1V / −0,5V	125kV		
125kV	200mA	PCB kV_control 4:	+0V	±0.5V	125kV		

Table 2: Factor Duty Cycle, 125kV limit

Example how to correct the Factor Duty Cycle:

PCB kV_control 3:

- If the mean value of U_{COMP} is: > +1V **increase** the Factor Duty Cycle in steps of 0.01
  < −0.5V **decrease** the Factor Duty Cycle in steps of 0.01

PCB kV_control 4:

- If the mean value of U_{COMP} is: > +0.5V **increase** the Factor Duty Cycle in steps of 0.01
  < −0.5V **decrease** the Factor Duty Cycle in steps of 0.01

- Check also the kV peak *value AV HT* (not the overshoot), it must be **125kV** for **125kV** setpoint.
- Remove short link EZ130 X23 *GAIN_IN*.
- Record the findings in table 2.

5. Tube replacement

Any new tube require a new adjustment procedure consisting of:

1. Tube conditioning
2. Tube adaptation

Warning!
Radiation is released during the adjustment procedure!

The generator must be in the READY state, i.e. the green ring at the desk must be illuminated!

5.1. Tube conditioning

5.1.1. Preconditions / Programmings

- Switch OFF the generator.

Preparation of generators which are connected via a CAN interface:

- BuckyDiagnost TH and TH2
- DigitalDiagnost
- Thoravision
- EasyDiagnost with bucky unit

- Disconnect the following plugs:

System	Connector		
	EZX23 signal bus	EZX42 or EZX42-1 system CAN	EZX43 or EZX43-1 system CAN
BukyDiagnost TH / TH2	X		X
DigitalDiagnost	X	X	X
Thoravision	X	X	X
EasyDiagnost with Bucky unit	X	X	X

- Switch ON the generator.

Note
The programming procedure must not be started before relays ENK1 has been energized at least 2 minutes after the generator has been switched ON.

- Perform the following programmings temporarily for each tube connected to one of the assigned RGDV = Free cassette
  Select menu XRGSCOPE:
  PROGRAM/ REGISTRATION DEVICES/ RGDV#/ **DATA SET A**

Programming	Temporarily	Original Tube
Enable handswitch	YES	Verify the customized entries in 2Z-2.x
Syncmaster present	NO	
Exposure switch type	Double Step	
Exposure series / Tomo	YES	
Mounted radiographic	NONE	

- RESET the generator.
- Select appropriate programmed RGDV = “Free cassette” for the tube to be conditioned.

5.1.2. Procedure

- Select **large** focus only.

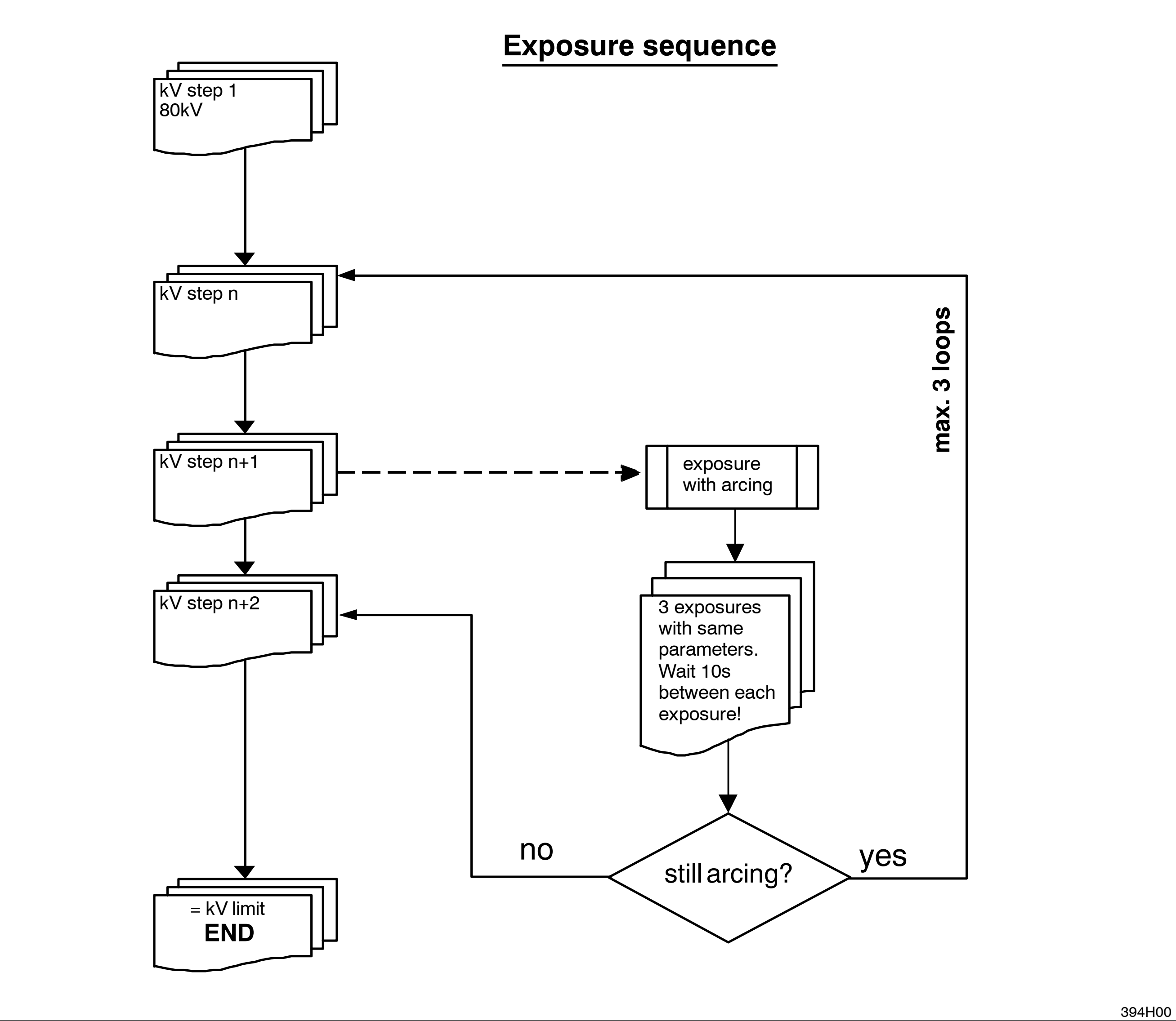
Note
The generator must be in the READY *state.*

- Run conditioning procedure for a new or non-adapted tube, refer to following table “Exposure parameters for conditioning“.
- It is recommended that the high tension be monitored during conditioning.
  Connect the scope:
  Channel1: kV AV HT at EZ130 X3 (1V/div), scale: 20kV/V
  Trigger external: CTRL_X_C/ at backpanel EZ X74, negative slope
  Time base: 2ms/div
- In case of problems like tube arcing see the following flowchart EXPOSURE SEQUENCE as an example.
  The flowchart applies for applicable kV range only, e. g.:
  109kV is the max. kV value for normal application, perform just up to next higher kV step = 117kV.

Note
Refer to flowchart EXPOSURE SEQUENCE.
If the tube arcs at a certain kV value, switch another 3 exposures with same parameters and 10s pause between subsequent exposures. In case of success (no arcing anymore) continue with next kV step of the following table.
If the last exposure still arcs go one kV step back and follow normal procedure. If this routine has been performed three times without improvement: ==> **Replace the tube!**

Exposure parameters for conditioning		
kV	**mAs**	**# exposures**
80	0.5	< 1 >
80	5	< 1 >
80	50	< 1 >
10 seconds pause		
80	100	< 1 >
1 minute pause		
90	0.5	< 1 >
90	5	< 1 >
90	50	< 1 >
10 seconds pause		
90	100	< 1 >
1 minute pause		
100	0.5	< 1 >
100	5	< 1 >
100	50	< 1 >
10 seconds pause		
100	100	< 1 >
1 minute pause		
110	0.5	< 1 >
110	5	< 1 >
110	50	< 1 >
10 seconds pause		
110	100	< 1 >
1 minute pause		
120	0.5	< 1 >
120	5	< 1 >
120	50	< 1 >
10 seconds pause		
120	100	< 1 >
1 minute pause		
130	0.5	< 1 >
130	5	< 1 >
130	50	< 1 >
10 seconds pause		
130	100	< 1 >
1 minute pause		

Exposure parameters for conditioning		
kV	**mAs**	**# exposures**
140	0.5	< 1 >
140	5	< 1 >
140	50	< 1 >
10 seconds pause		
140*	100	< 1 >
1 minute pause		
145	0.5	< 1 >
145	5	< 1 >
145	50	< 1 >
10 seconds pause		
145	100	< 1 >
1 minute pause		
148	0.5	< 1 >
148	5	< 1 >
148	50	< 1 >
10 seconds pause		
148	100	< 1 >
1 minute pause		
150	0.5	< 1 >
150	5	< 1 >
150	50	< 1 >
10 seconds pause		
150	100	< 1 >
1 minute pause		



Note

If a tube arcs at any kV value which is not required for application the max. kV (e.g.117kV) program this new limit value by XRGSCOPE:

PROGRAM/ TUBES/ TUBE LIMITS/ MAX. TUBE VOLTAGE LIMIT [kV]/ **[117]**

As the limit value decreases for this reason, a following re-adaptation procedure sets the field ADAPTED TO [kV] to this value as well.

- Set RGDV programming to original status if no adaptation procedure has to be executed.
- RESET the generator.

5.2. Tube adaptation

5.2.1. General information

Tube adaptation is an automatic process which includes:

1. The measurement of the mA offset value that is caused by:
   - the kV measuring circuit
   - the emission current feedback circuit (VCO)

2. The measurement of the individual standby filament current (based on 100μA).

3. The emission current characteristic as f (kV, filament current).

4. The dynamic behavior (positive and negative boost adaptation) where the inertia of the filament with respect to heating up and cooling down is registered.
   For more information refer to section 3: FAULT FINDING.

Note
In case of problems check the symptom / solution list at the end of this adjustment chapter. Repeat the adaptation for this particular focus.

5.2.2. Preconditions / Programmings

- Reset the generator.

Note
The adaption procedure must not be started before relay ENK1 has been energized at least 2 minutes after the generator has been switched ON.

- The tube must be conditioned as described in chapter 5.1.

- Check the upper kV limit
  Select menu XRGSCOPE:
  PROGRAM/ TUBES/ TUBE LIMITS/ **MAX. TUBE VOLTAGE LIMIT [kV]**

  The programmed value should match the nominal value of the tube connected or in case of older tubes the upper kV limit should be set to the max. application kV.
  Once an adaptation is completed the new limit value indicates as ADAPTED TO [kV].

- Perform the following programmings temporarily for each tube connected to one of the assigned
  RGDV = Free cassette
  Select menu XRGSCOPE:
  PROGRAM/ REGISTRATION DEVICES/ RGDV#/ **DATA SET A**

<table>
<tr><th>Programming</th><th>Temporarily</th><th>Original Tube</th></tr>
<tr><td>Enable handswitch ......</td><td>YES</td><td rowspan="5">Verify the customized entries in 2Z-2.x</td></tr>
<tr><td>Syncmaster present</td><td>NO</td></tr>
<tr><td>Exposure switch type</td><td>Double Step</td></tr>
<tr><td>Exposure series / Tomo ......</td><td>YES</td></tr>
<tr><td>Mounted radiographic ......</td><td>NONE</td></tr>
</table>

5.2.3. Procedure

- RESET the generator.
- It is recommended that the high tension be monitoredduring adaptation.
  Connect the scope:

Channel1:	kV AV HT at EZ130 X3 (1V/div), scale: 20kV/V
Trigger external:	CTRL_X_C/ at backpanel EZ X74, negative slope
Time base:	2ms/div

- Select the RGDV = Free cassette for the tube to be adapted.
- Select menu XRGSCOPE:
  OPTIMUS XRG/ ADJUST/ **TUBE ADAPTATION**
- Select the tube and focus to be adapted, start with small focus!

  Note
  To avoid any malfunction make sure that READY is displayed on the desk before transmitting data by pushing <F2>:
  READY state disappears, ADAP is displayed on the desk, WAITING is displayed on the PC screen.
  Wait until the generator turns back to READY state.

- Start the adaptation process by pushing the handswitch in PREP and EXP position continuously.

  The generator switches about 125 exposures for each focus. The radiation sign at the desk indicates exposures but there is no beep at the end of each exposure.
  The actual kV parameters are displayed during adaptation.

  The generator carries out the adaptation automatically. The procedure for one focus is completed when the desk indication changes from ADAP to TEST. The WAITING message disappears from the PC screen together with a PC beep, followed by the screen: BEFORE CONTINUING THE GENERATOR MUST BE RESET.

- RESET the generator.
- Run the adaptation for each focus (small and large) and tube.

  Note
  As there is no tube type with a physical third (middle) focus yet, the third focus cannot be adapted.
  VARIOFOCUS values are calculated by adapted small and large focus. APR programs using VARIOFOCUS can only be selected until small and large focus are both adapted.

- Set RGDV(s) programming to original status according *table “RGDV programming”* 2Z–2.x in the end of this chapter.

5.3. Final tube adjustment work

1. BuckyDiagnost TH with CAN interface, DigitalDiagnost, Thoravision:

   - Switch OFF the generator.
   - Reestablish signal bus connector EZX23.
   - Reestablish CAN connectors EZX42-1 and EZX43-1.
   - Switch ON the generator.

2. All other systems:

   - Reset the generator

5.4. Symptoms and solutions if problems occur during tube adjustment

1. A warning cannot be displayed on the control desk, the WAITING screen on the PC is flickering instead during this event and logged in the error log index.

2. If the tube has already been at a high temperature level (but the tube load indication still indicates green or green-yellow for 100% power) it might happen that the tube load indication changes straight to red and the adaptation is on hold. WAITING is flickering on the PC.
   Solution: Keep the handswitch pushed, once the temperature is down adaptation continues automatically.

   Note
   An increment of one of the temperature levels inhibits the 100% power condition. This event is always logged as warning 00BV in the error log index.

3. An error message just flashes for a very short moment and instantly covered by ADAP on the desk afterwards. WAITING is flickering on the PC.

4. All buttons at the control desk including the RESET button are inactive during adaptation.
   The only way to RESET an error is to release the PREP switch which causes an interrupt similar to the RESET command.

5. After letting of of the PREP switch wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.

6. If adaptation seems to do nothing for more than 30 seconds let go of the PREP switch. Wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.

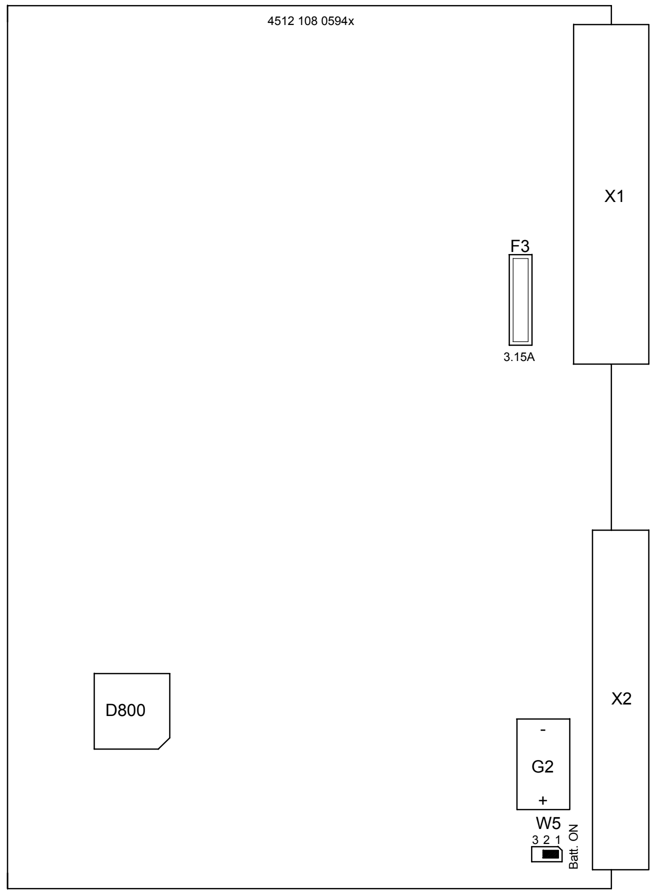
7. If a constant READY indication appears for more than 2 seconds while PREP and EXP is activated by the handswitch during adaptation let go of the handswitch.
   Wait until the desk indicates READY. If READY does not appear at least after 20 seconds run a warmstart of the generator by pushing the RESET button on CU EZ139.

8. If adaptation does not carry on with or without READY indication check whether one of the function units indicates a FATAL error by turning on the red LED. Let go of the handswitch and warmstart the generator by pushing the RESET button on CU EZ139.

9. If adaptation has been interrupted by a generator warmstart check the error log index before restarting adaptation:
   kV errors 02WG and/or 02WH indicate tube arcing. Run conditioning of the tube as described in section 2 “INSTALLATION” and/or reduce the max. kV value to the required application value.

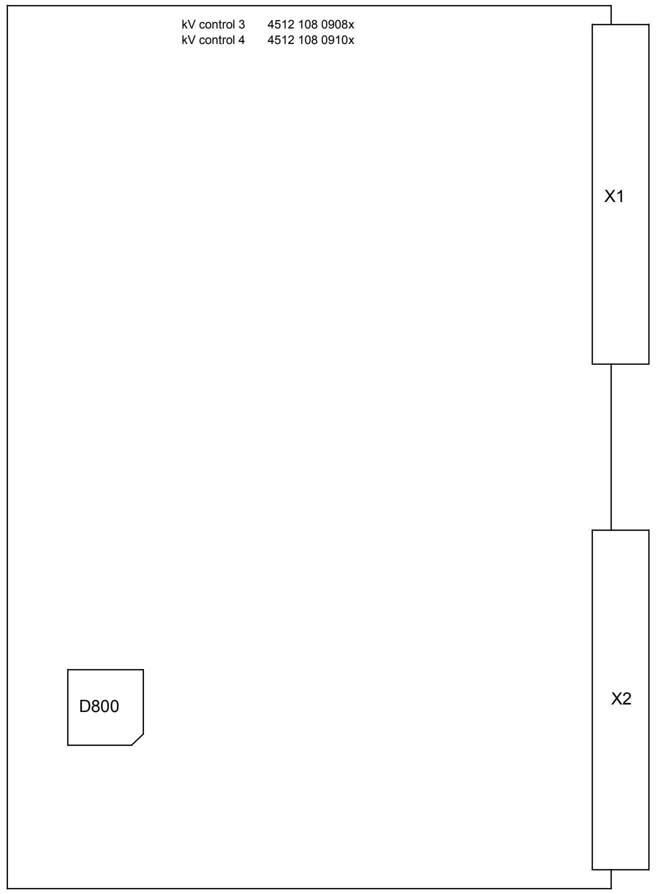
Attention: Do not forget to set the jumper
of the battery in the position "Batt. ON":
EZ119: W5
EZ139: W1

EZ 119 mA control



D800 = 4512 113 20211
= 4512 113 20212

EZ 130 kV control 3/4



D800 = 4512 113 20132 RAD
D800 = 4512 113 26212 R/F

kV control 3 ≥ 4512 108 09081
kV control 4 ≥ 4512 108 09101

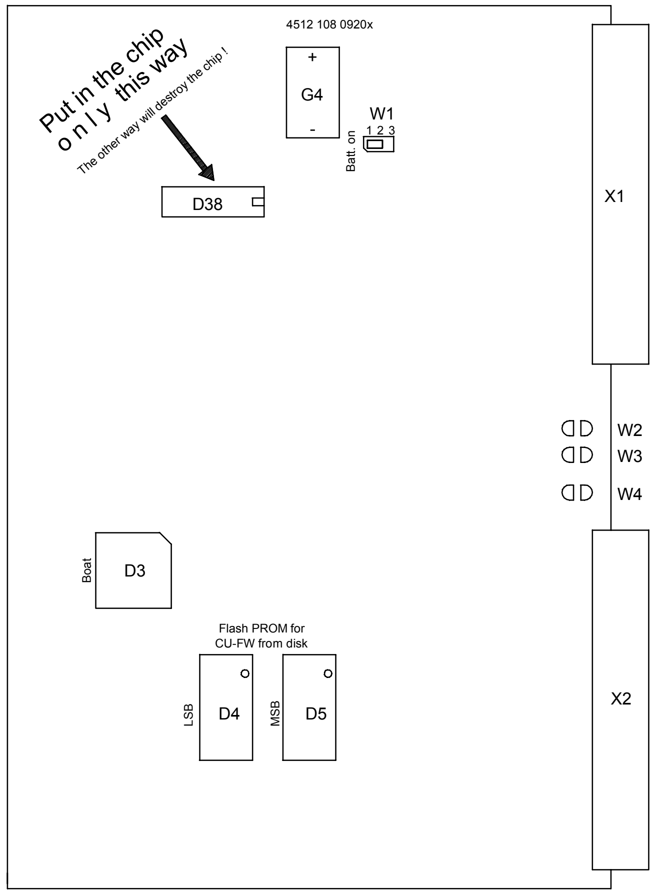
- OPTIMUS R/F
- OPTIMUS C

D800 = 4512 113 26211
= 4512 113 26212

- OPTIMUS RAD

D800 = 4512 113 20131
= 4512 113 20132

EZ 139 Central unit



D38 = function key,
marked with s/n of the generator

OPTIMUS R/F :
OPTIMUS RAD :

Boot- FW D3 = 4512 113 20731

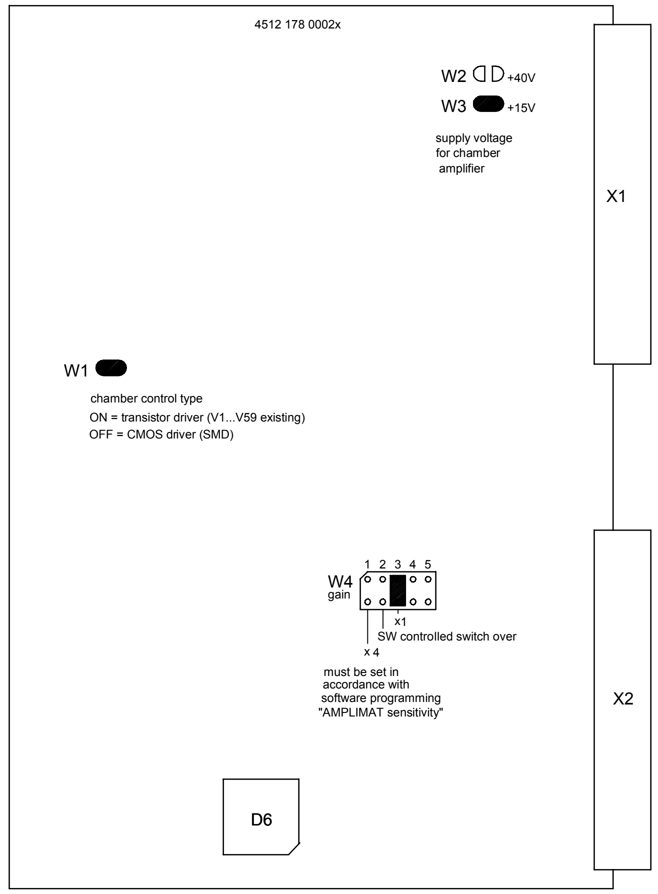
Cu - FW Rel 3.5 = 9890 000 02512 (4512 114 20835)
Cannot be ordered. Use OMA0220x. exe disk for flash PROM loading.

OPTIMUS C :

Boot- FW D3 = 4512 113 27001

Cu - FW Rel 1 = 9890 000 02541 (4512 114 26901)
Cannot be ordered. Use OMC0241x. exe disk for flash PROM loading.

EZ 150 Basic interface



PCB layout print different from figure.

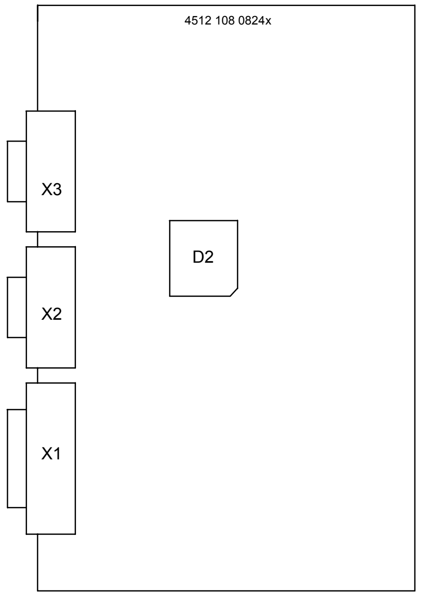
D6 = 4512 113 20311

A1/A3 01-11-12 Schr.

PCB programming
central rack EZ

Operating desk C 1)

C 300 CPU

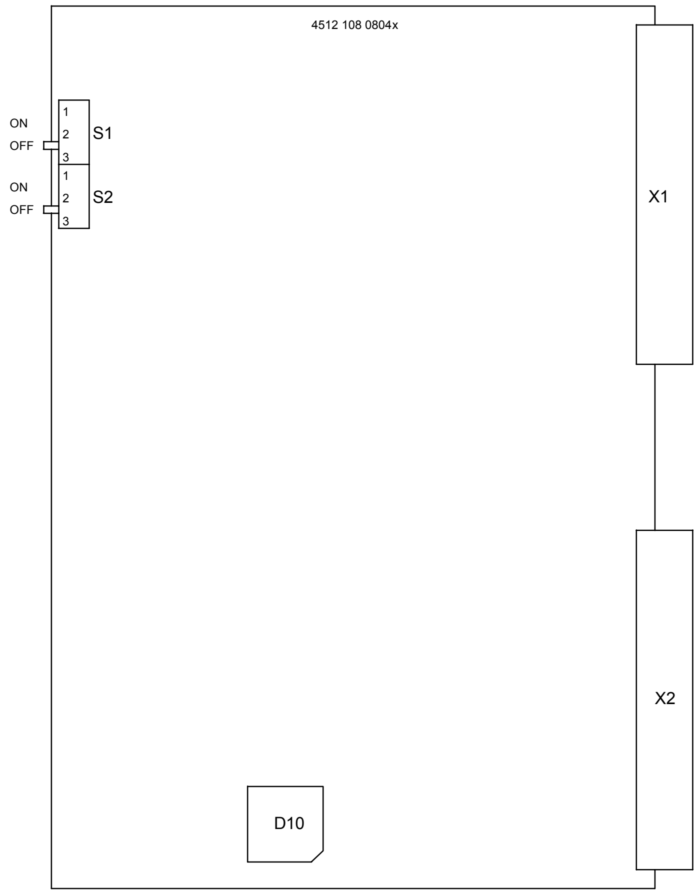


1) not for OPTIMUS C

D2 = 4512 113 20521
= 4512 113 20522
= 4512 113 20523
= 4512 113 20524
= 4512 113 20525

Adapter decade cable WA, 1WA, 2WA, 1WB 1)

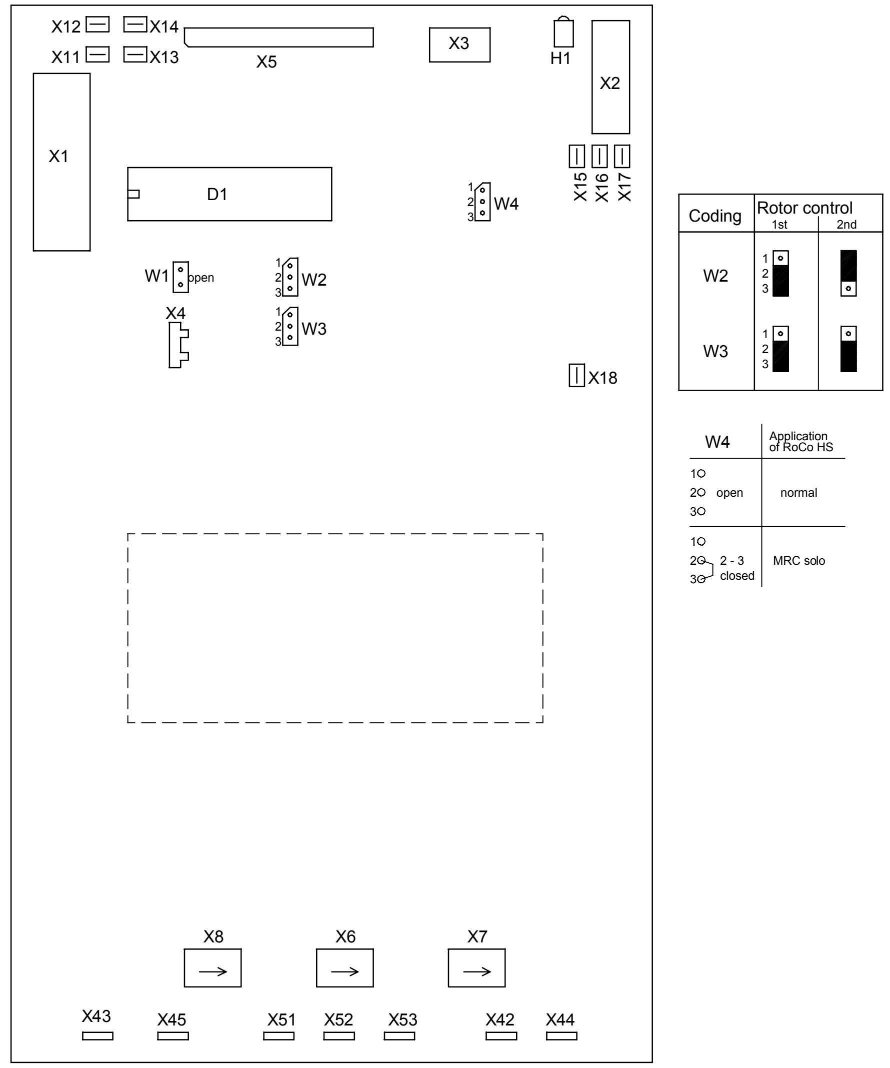
WB/WA 102 Universal I/O interface



D10 = 4512 113 20611

Ro Dual speed rotor control Y 9890 000 02662
Dual speed rotor control OPTIMUS Y 9890 000 0268x

Y 100 Roco HS 4512 108 0974x



D1 = 4512 113 22321
= 4512 113 22322
= 4512 113 22323

A1/A3 01-11-01 Schr.

PCB programming
Options

ADJUSTMENTS

TEXT

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1. Area Dose Calculator (option)

Special tools:
- calibrated dosemeter, e.g. DALI with measuring cell 77334 or PMX3
- 1mm lead plate

The following parameters are relevant for calculation:
- SID (**S**ource **I**mage **D**istance)
- diaphragm aperture
- added filters
- specific yield of tube
- mAs product
- number of exposures

SID, diaphragm aperture and type of filters are supplied by the diagnostic unit, where they are also adjusted.
In the generator default values are given for the specific yield of a tube and filter correction.
These default values can be found as reference files on floppy disk in order to recreate the original settings if need be.

Reference files:

ref_yiel.tdl	specific yield of tube
ref_2al.tdl	filter 2mm Al
ref_01cu.tdl	filter 1mm Al + 0.1mm Cu
ref_02cu.tdl	filter 1mm Al + 0.2mm Cu

The specific yield curve relates to tungsten anodes and 2.5mm primary filters.
Display on the desk is in [cGycm^2].

1.1. Checking the default adjustment

- Place the lead plate and the measuring cell of the measuring instrument on the table in the central radiation beam. The purpose of the lead plate is to reduce radiation scatter of the table top. Without the plate the test result would be approximately 10% higher using a table top made, for example, of resin bonded paper.

- Perform the following settings:
  - 1m between the focus and the measuring cell (= SMD **S**ource **M**easuring **D**istance)
  - free cassette technique
  - kV-mAs-s technique
  - 10mAs
  - 0.1s
  - collimation 10 x 10cm at the height of the measuring cell
  - no filter

- Determine area dose at the following kV settings and compare it with the respective value displayed on the desk:

	50kV	**80kV (81kV)**	**120kV (117kV)**
displayed product	.... $cGycm^2$	.... $cGycm^2$	.... $cGycm^2$
measured dose	.... cGy	.... cGy	.... cGy
measured area (X x Y)	.... cm^2	.... cm^2	.... cm^2
calculated product	.... $cGycm^2$	.... $cGycm^2$	.... $cGycm^2$
difference	.... %	.... %	.... %

Example:

- displayed area dose product: 8.8$cGycm^2$
- measured dose: 890μGy = 0.089cGy
- calculated area dose product: measured dose $\times$ exposed area = 0.089cGy $\times$ 100cm^2 = 8.9$cGycm^2$
- difference in %: $= \frac{8.9 - 8.8}{8.9} \times 100 = 1.12\%$

- If there are any deviations of over 5% it is recommended that the yield curve be corrected in accordance with the procedure described in 1.2.

1.2. Correction of the specific yield

Prerequisite:

- Test setup and settings in accordance with section 1.1.:
  - 1m between the focus and the measuring cell (= SMD)
  - free cassette technique
  - kV-mAs-s technique
  - 10mAs
  - 0.1s
  - collimation 10 x 10cm at the height of the measuring cell
  - no filter

Principle:

- For each kV specified a dose measurement is taken under the same conditions. If the distance between the focus and the measuring cell deviates from 1m, all the dose values must be corrected with the square of distance (unit of measurement is [m]). Dividing the dose values by the mAs product set gives the respective current yield.

Procedure:

- Measure dose at each kV checkpoint and use it to calculate specific yield.

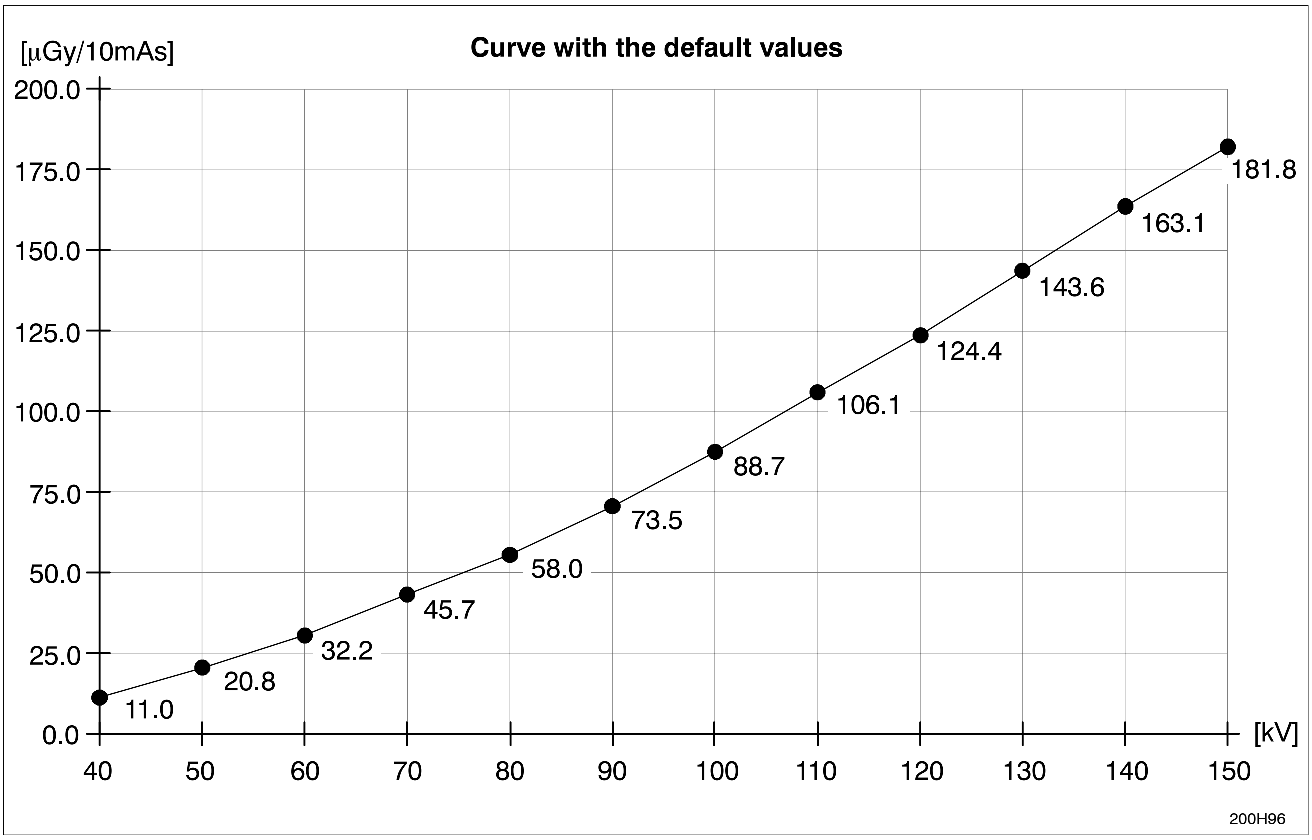
  The values determined must be higher at higher kVs settings and produce a characteristic with a slight curve on the graph. If considerable fluctuations are detected, the measurements must be repeated at the points in question.

  Range: 0.00 ... 400.00µGy/mAs

  The values can only be stored in the generator if they are within the range specified and rise uniformly with kV.

Specific yield

kV checkpoint	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
default yield [µGy/10mAs]	**11.0**	**20.8**	**32.2**	**45.7**	**58.0**	**73.5**	**88.7**	**106.1**	**124.4**	**143.6**	**163.1**	**181.8**
measured dose [µGy]												
distance^2 factor	If the distance focus – measuring cell (= SMD) differs from 1m correct the dose with the factor: distance^2 factor = (SMD [m] / 1m)^2 = ... (e.g. = 1.44 for a SMD of 1.2m)											
corrected dose [µGy]												
specific yield [µGy/10mAs]	specific yield = corrected dose/10mAs											



- Correct the default values of the specific yield for all the kV checkpoints.
  Select menu:
  ADJUST/ AREA EXPOSURE PRODUCT/ **SPECIFIC YIELD OF TUBE 1 ... 3**
  with the factor determined and save with <TRANSMIT>.

- Save the specific yield curve with the SAVE function of XRGSCOPE <F3> key on the backup disk.
  Recommended file name: act_yiel.tdl

1.3. Correction of the filter values

Prerequisite:

- Test setup and settings in accordance with section 1.1.
  - 1m between the focus and the measuring cell (= SMD)
  - free cassette technique
  - kV-mAs-s technique
  - 10mAs
  - 0.1s
  - collimation 10 x 10cm at the height of the measuring cell
  - no filter

Principle:

- At otherwise identical settings the dose is determined for the kV values specified with and without filter. The ratio of dose values with / without filter produces the respective current correction factor.

Procedure:

- Accept measured dose values (not the corrected ones!) for the respective kV checkpoints from yield measurement or measure them again if any changes have been made to the test-setup or settings.

- Move the filter to be checked into the radiation beam.

- Measure dose at each kV checkpoint and enter it in the respective table.

  Note
  The 40kV range is not used in practice so it does not have to be corrected.
  If in the lower kV range the considerably reduced dose can no longer be measured or read perfectly, at that point a higher mAs product must be selected. Then the repeat measurement must be performed without filter.

- Using the ratio between dose with and without filter, determine the respective correction factor.

  The values determined must be higher at higher kVs settings and produce a characteristic with a slight curve on the graph. If considerable fluctuations are detected, the measurements must be repeated at the points in question.

  Range: 0.000 ... 1.000
  The values can only be stored in the generator if they are within the range specified and rise uniformly with kV.

- Perform the procedure for each selectable filter type.

Filter correction – 2mm Al

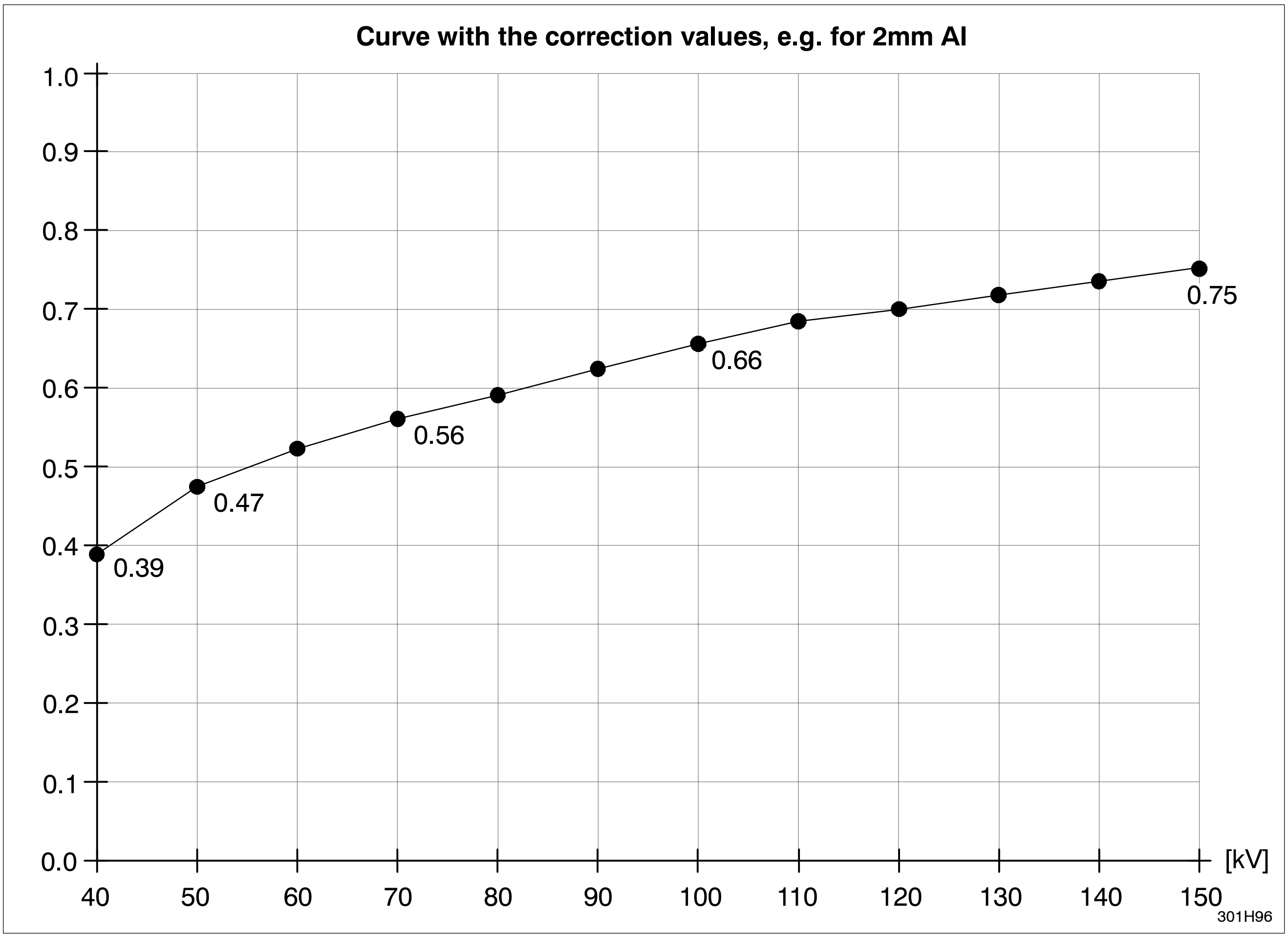
kV-checkpoint [kV]	50	70	100	150
default factor	**0.47**	**0.56**	**0.66**	**0.75**
measured dose [µGy] with filter				
measured dose [µGy] without filter				
new factor	**new factor = dose with filter / dose without filter**			

Filter correction – 1mm Al + 0.1mm Cu

kV-checkpoint [kV]	50	70	100	150
default factor	**0.25**	**0.37**	**0.50**	**0.65**
measured dose [µGy] with filter				
measured dose [µGy] without filter				
new factor	**new factor = dose with filter / dose without filter**			

Filter correction – 1mm Al + 0.2mm Cu

kV-checkpoint [kV]	50	70	100	150
default factor	**0.123**	**0.230**	**0.370**	**0.53**
measured dose [µGy] with filter				
measured dose [µGy] without filter				
new factor	**new factor = dose with filter / dose without filter**			



- Read out the default values of the filter tables for each kV checkpoint, correct with the factor determined and write back into the generator with <Transmit>.

  Select menu:
  ADJUST/ AREA EXPOSURE PRODUCT/ ADD FILTER CORRECTION TABLES/ ...

  ... 2mm AL

  ... 1mm AL + 0.1mm CU

  ... 1mm AL + 0.2mm CU

- Save the specific correction tables with the SAVE function of XRGSCOPE <F3> key on the backup disk.

  Recommended file names:

act_2al.tdl	filter 2mm Al
act_01cu.tdl –	filter 1mm Al + 0.1mm Cu
act_02cu.tdl	filter 1mm Al + 0.2mm Cu

2. Alignment of "Function Unit kV"

2.1. General information

The actual value of the set kV must be attained at least after 2ms. At kV rise phase there must be neither kV break-in nor a kV overshoot.

The Factor Duty Cycle is based on an adapted tube and determines at local mains voltage and mains resistance conditions:

- the kV rise phase

  and

- the kV behavior during the exposure in falling load technique

  as it takes into account the tolerances of the following FRUs (**F**ield **R**eplaceable **U**nits):

1. PCB EZ 130			**
kV_control_3 = 50kW	1 converter	4512 108 0908x	
kV_control_4 = 65/80kW	2 converters	4512 108 0910x	
2. A complete power converter unit Q			**
kV_power PCB(s) Q100	(part of the power converter unit)		
IGBT transistors	(part of the power converter unit)		
3. Resonance capacitors	(part of the power converter unit)		**
4. High tension transformer			**

An exchange of one of the ****** marked parts requires a realignment of the Factor Duty Cycle.

The Factor Duty Cycle is stored in the memory of PCB CU EZ139. If the CU has to be replaced the CU complete backup can be reloaded (with the actual factor) to the NVRAM memory or the Factor Duty Cycle must be re-aligned. Refer to figure 1:

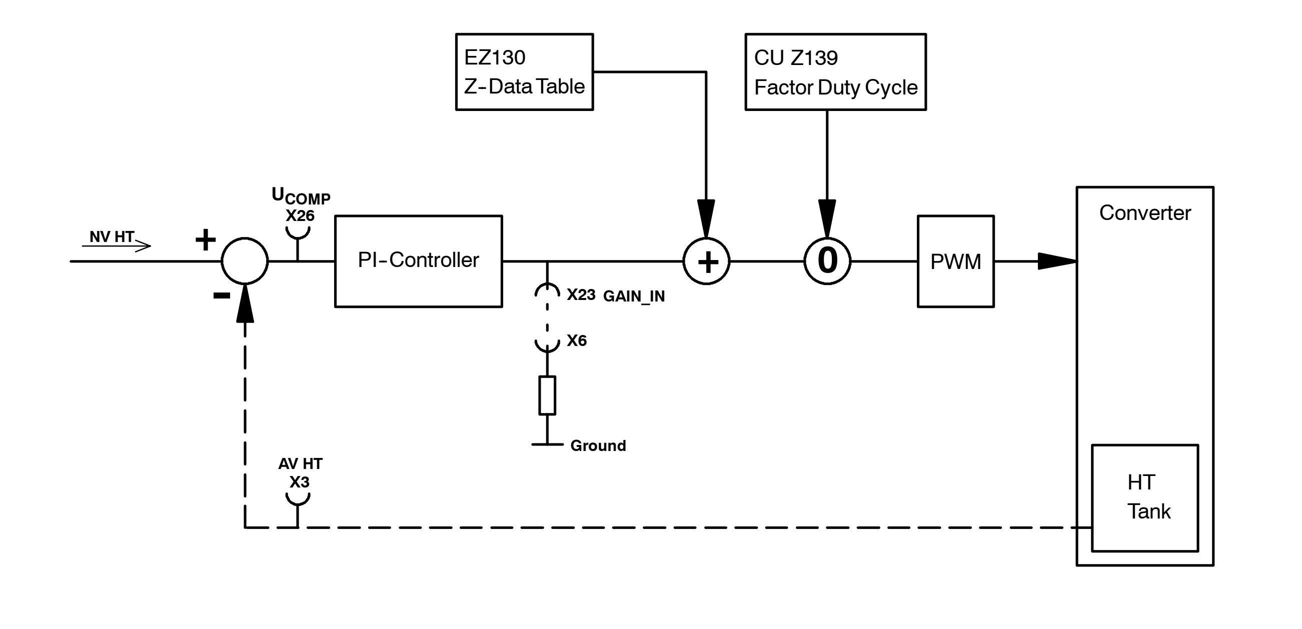


Figure 1
395H00

During alignment this Factor Duty Cycle must be entered via XRGSCOPE. The influence of this factor as a correction value for the Z-Data Table is monitored as the U_{COMP} signal, since the PI-Controller is deactivated by the grounded *GAIN_IN* signal.

2.2. Connecting and setting the scope

For connections see figure 2:

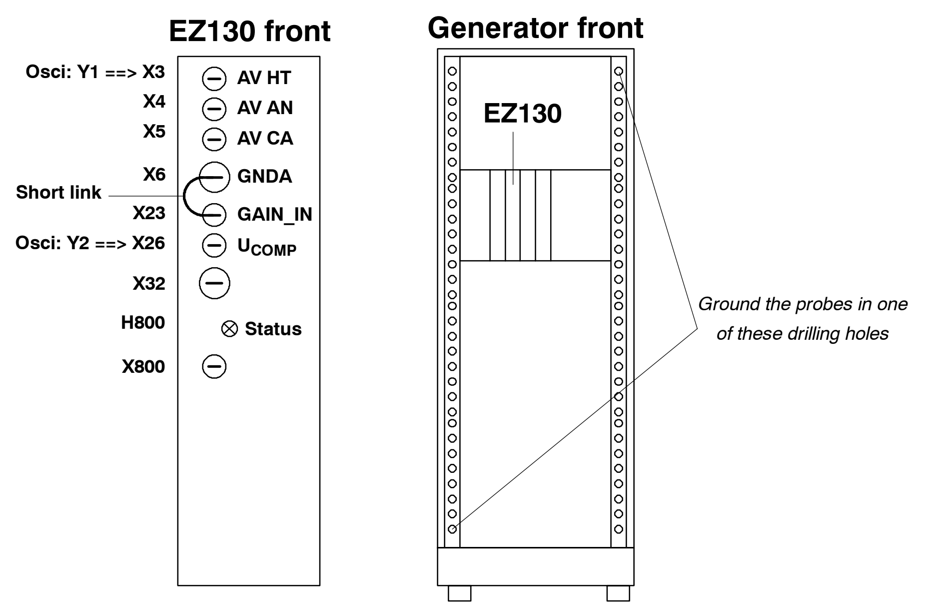


Figure 2 396H00

Channel 1 = EZ130 X3 ---> *AV HT* ---> 20kV/V ---> 1V/div --> Zero-line at bottom of screen
Probe GND = one of the drilling holes at the front cabinet chassis

Channel 2 = EZ130 X26 ---> U_{COMP} ---> 1V/div ---> Zero-line 2 div from bottom of screen
Probe GND = one of the drilling holes at the front cabinet chassis

Trigger = external (preferred) ---> *CTRL_X_C/* ---> backpanel EZX74 / negative slope
or = internal channel 1 ---> *AV HT* ---> EZ130 X3 / positive slope at +3V
Probe GND = one of the drilling holes at the front cabinet chassis

Time base = 5 or 10ms/div ---> trigger delay -1div

Note
A digital scope should not have any other ground connection than the ground of the 3 probes at the drilling holes at the front generator chassis.
A mains-driven scope must be isolated from earth potential, otherwise it might display artefacts.

2.3. Deactivating the kV controller

- Connect EZ130 X23 *GAIN_IN* and X6 *GNDA* with a short link (use a short wire).

Caution!

This alignment requires exposures with high kV.
Be sure the tube has been warmed up before.

2.4. Setting of exposure data

a) Set 141kV in case of

- 65/80kW
- the tube limit (of at least one tube) is 150kV perform this adjustment at the tube which has the highest kV limit programmed.

b) Set 125kV in case of

- 50kW

  and
- 65/80kW if the programmed application limit of the tube limit is 125kV.

Note
Any tube arcing during this adjustment requires the execution of the tube conditioning next as described in section 2 "INSTALLATION".
Disconnect the short link between X23 and X6.
Start over this adjustment from chapter 2.3 onwards if the tube conditioning was successful.

- Set kV and mA values according to the programmed tube limits:

a) 141kV:	200mA	at kV_4	(65/80kW)
b) 125kV:	100mA	at kV_3	(50kW)
	200mA	at kV_4	(65/80kW)

- Set exposure time: 40ms

2.5. Adjustment of the ”factor for duty cycle”

- Adjust the Factor Duty Cycle via service software XRGSCOPE by measuring U_{COMP} with the scope.
- Connect the service PC and start XRGSCOPE:
  XRGSCOPE
  SELECT UNIT ---> FU-kV ---> ADJUST ---> IGBT Pulse Width Correction ---> Factor Duty Cycle
- Set the starting value Factor Duty Cycle to **1.00**:

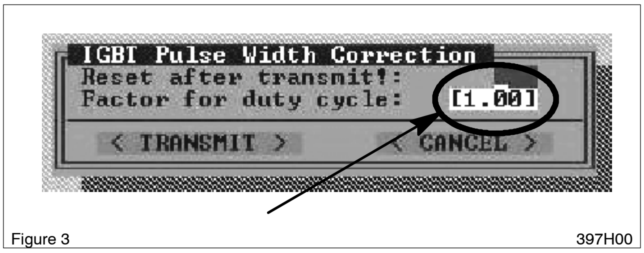
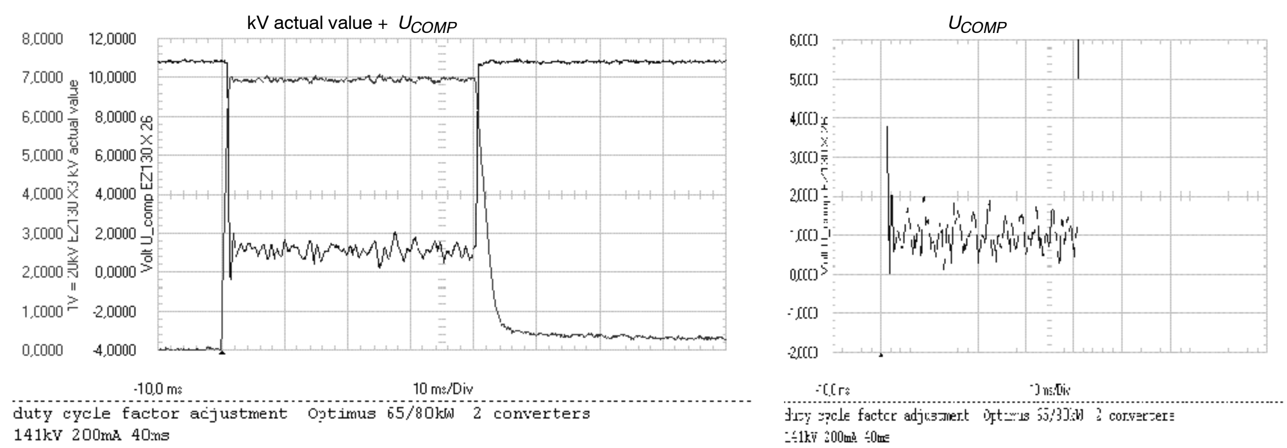


Figure 3 397H00

- If the U_{COMP} value does not match the requirements type in another Factor Duty Cycle value, <TRANSMIT> the screen and push the active RGDV button to get the new value validated.
- Switch an exposure.
  The values are measured in the stationary condition. The transient behavior at the beginning of the exposure is not taken into account.

Result: In standby the U_{COMP} value is at about +11V, during exposure the mean value U_{COMP} must be as given in table 1 or 2, refer to figure 4:



Oscillogram of a perfect alignment for 141kV

U_{COMP} for 141kV

Figure 4 401H00

a) 141kV setting (65/80kW only)

- Read the mean value of U_{COMP} for 141kV (see scope figure 4 or 5), correct the Factor Duty Cycle till U_{COMP} meets the required reference of +1V.

kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of *AV HT*	Factor Duty Cycle:	Date:
141kV	200mA	PCB kV_control 4:	+1V	±0.5V	138kV		

Table 1: Factor Duty Cycle, settings 141kV (150kV limit)

Example how to correct the Factor Duty Cycle:

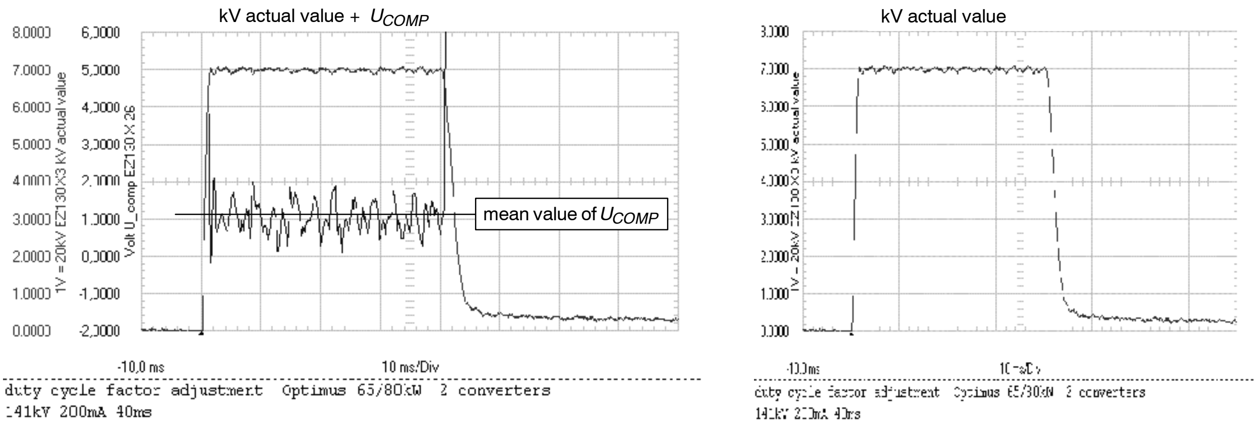
PCB kV_control 4:

- If the mean value of U_{COMP} is: > +1.5V **increase** the Factor Duty Cycle in steps of 0.01
  < +0.5V **decrease** the Factor Duty Cycle in steps of 0.01

- Check also the kV peak value *AV HT* (not the overshoot), it must be **138kV** for **141kV** setpoint. (see scope figure 5)

- Remove short link EZ130 X23 *GAIN_IN*.

- Record the findings in table1.



Optimus 80kW with 141kV, U_{COMP} = +1V

AV HT with overshoot

Figure 5

402H00

b) 125kV setting (50/65/80kW)

- Read the mean value of U_{COMP} for 125kV (in principle figure 4 or 5).
- Correct the Factor Duty Cycle till U_{COMP} meets the required reference of 0V.

kV setpoint	mA setpoint	PCB type	U_{COMP}	Tolerance	kV peak of *AV HT*	Factor Duty Cycle:	Date:
125kV	100mA	PCB kV_control 3:	+0V	+1V / −0,5V	125kV		
125kV	200mA	PCB kV_control 4:	+0V	±0.5V	125kV		

Table 2: Factor Duty Cycle, 125kV limit

Example how to correct the Factor Duty Cycle:

PCB kV_control 3:

- If the mean value of U_{COMP} is: > +1V **increase** the Factor Duty Cycle in steps of 0.01
  < −0.5V **decrease** the Factor Duty Cycle in steps of 0.01

PCB kV_control 4:

- If the mean value of U_{COMP} is: > +0.5V **increase** the Factor Duty Cycle in steps of 0.01
  < −0.5V **decrease** the Factor Duty Cycle in steps of 0.01

- Check also the kV peak value *AV HT* (not the overshoot), it must be **125kV** for **125kV** setpoint.
- Remove short link EZ130 X23 *GAIN_IN*.
- Record the findings in table 2.

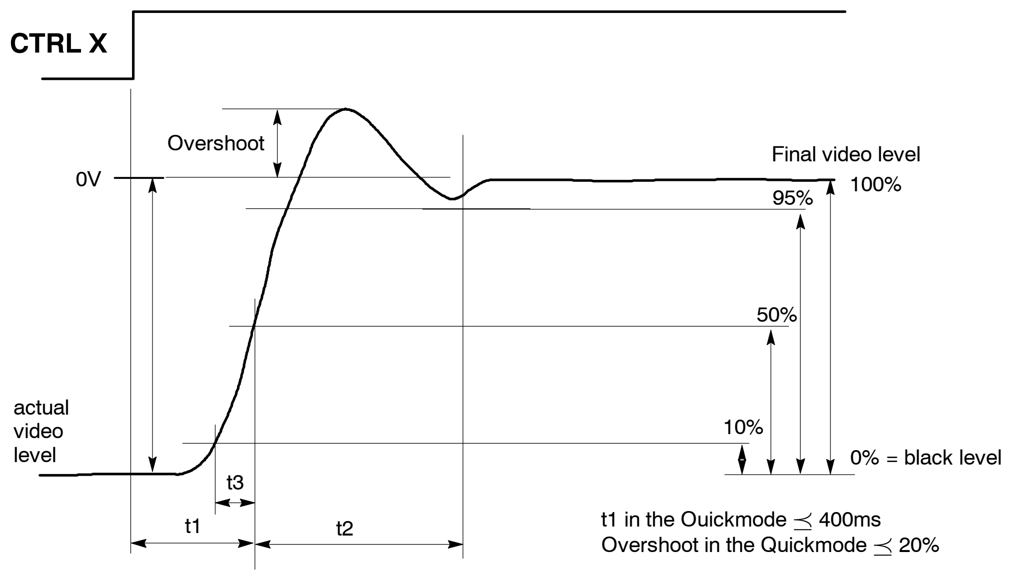
3. Dose rate alignment for continuous fluoroscopy when using the dose-rate signal DR TV (formerly ADC) // dose-rate control via TV-chain

3.1. Aim

The amplification factor of the control circuit must be adjusted such that
- the TV image becomes visible within about 400ms after fluoroscopy is switched ON with RQXGFL
- there is no flashing of the TV image (overshoot < 20%).

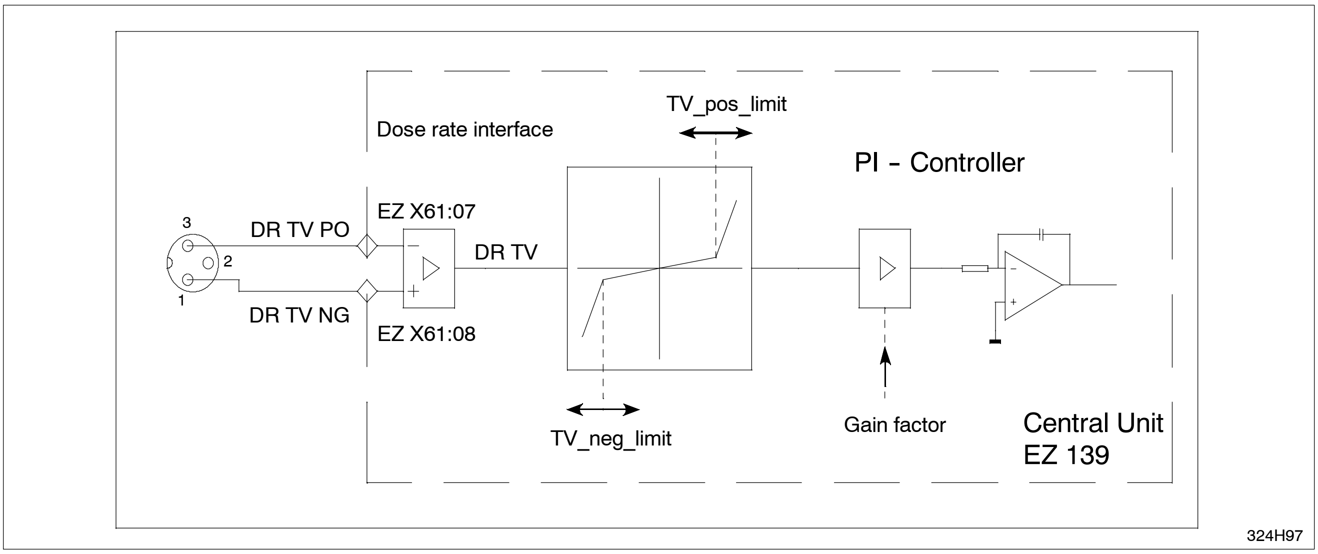
Also see sketch below:

Principle of "Transition function of DR TV"



3.2. Principle

Adjusting value : Transition function of DR TV
Variables : TV_pos_limit / TV_neg_limit / Gain factor



- Set the gain factor to default value = 1.00 with FW XRGSCOPE:

OPTIMUS
--> Adjustments
--> Dose rate control
--> Amplification gain
--> CONT **Gain factor 0.5...2 (default = 1): [1.000]**

- With fluoroscopy **switched OFF**, measure the black level of the dose-rate signal of the TV chain.
  Suitable test points:
  - WN 25 DRDFP (with a TV chain XTV 11)
  - (EZ X61:7 = DR TV PO)

  The kink of the characteristic curve TV_pos_limit to be adjusted must be:
  TV_pos_limit = DR TV PO (black level measured) - 500mV
  Example: DR TV PO = 7.3V → adjusting value TV_pos_limit = 6.8V

- Set TV_pos_limit via XRGSCOPE:
  OPTIMUS
  --> Program
  --> Dose rate control
  --> **CONT:**

Program settings for continuous fluoroscopy:

```
+---------- CONT_MOD.TDL ----------+
| scantime_TV [ms]:   [ 20.000] |       → 50Hz = 20ms
| scantime_TV valid:      Yes❑  |       → yes with control via TV chain.
|                               |         With photo diode = no.
| P_max_EDL [W]:       [  250]  |       → 250 default: Effective only when SID
|                               |         WB X12:1 DRLM is switched ON.
| TV_pos_limit [V]:     [6.8]   |       → DR TV PO - 500mV.
|                               |         (TV black voltage - about 500mV)
| TV_neg_limit [V]:     [-6.8]  |       → = - TV_pos_limit [V]
|---------------------------------|
|   < OK >                        |
|---------------------------------|
```

In case the switch ON procedure is fast enough with this setting
T1 ≦ 400ms in quick mode or T1 ≦ 500ms in normal mode
and the TV chain does not flash when fluoroscopy is switched ON,
overshoot ≦ 20%
the alignment with the oscilloscope described below is **not** required.

3.3. Alignment of DR TV with the oscilloscope

Settings of the oscilloscope:

Y1	to EZ 150 X6	:	EN X C/	[10V/div]
Y2	e.g. with XTV11 to WN 25	:	DRDFP	[5V/div]
Ground	to EZ 150 X5	:	GNDA	
Time base		:	200ms/div	
Trigger		:	Y1 / - DC	

The alignment should not be carried out in the quick mode since the differences of the transition functions are not big enough in the quick mode. However, in the normal mode the overshoot is slightly higher than 20%.

Since fluoroscopy is automatically in the quick mode for up to 30s after the end of fluoroscopy, after each oscillogram fluoroscopy must be switched OFF for at least 30s:

Pause > 30s → Fluoro ON → Oscillogram → Fluoro OFF
→ Pause > 30s → Fluoro ON → Oscillogram → Fluoro OFF
→ ...

Fluoroscopy adjustments for all oscillograms:

- Dark voltage of the TV chain measured: DR TV PO $_{dark}$ = 7.3V

XRGSCOPE:

OPTIMUS
--> Program
--> Dose rate control
--> **CONT:**

```
scantime_TV [ms]      :  20.000  (→ 50Hz)
scantime_TV valid     :  Yes
P_max_EDL [W]         :  250
```

Operating point of fluoroscopy in the automatic mode (example XTV 11):

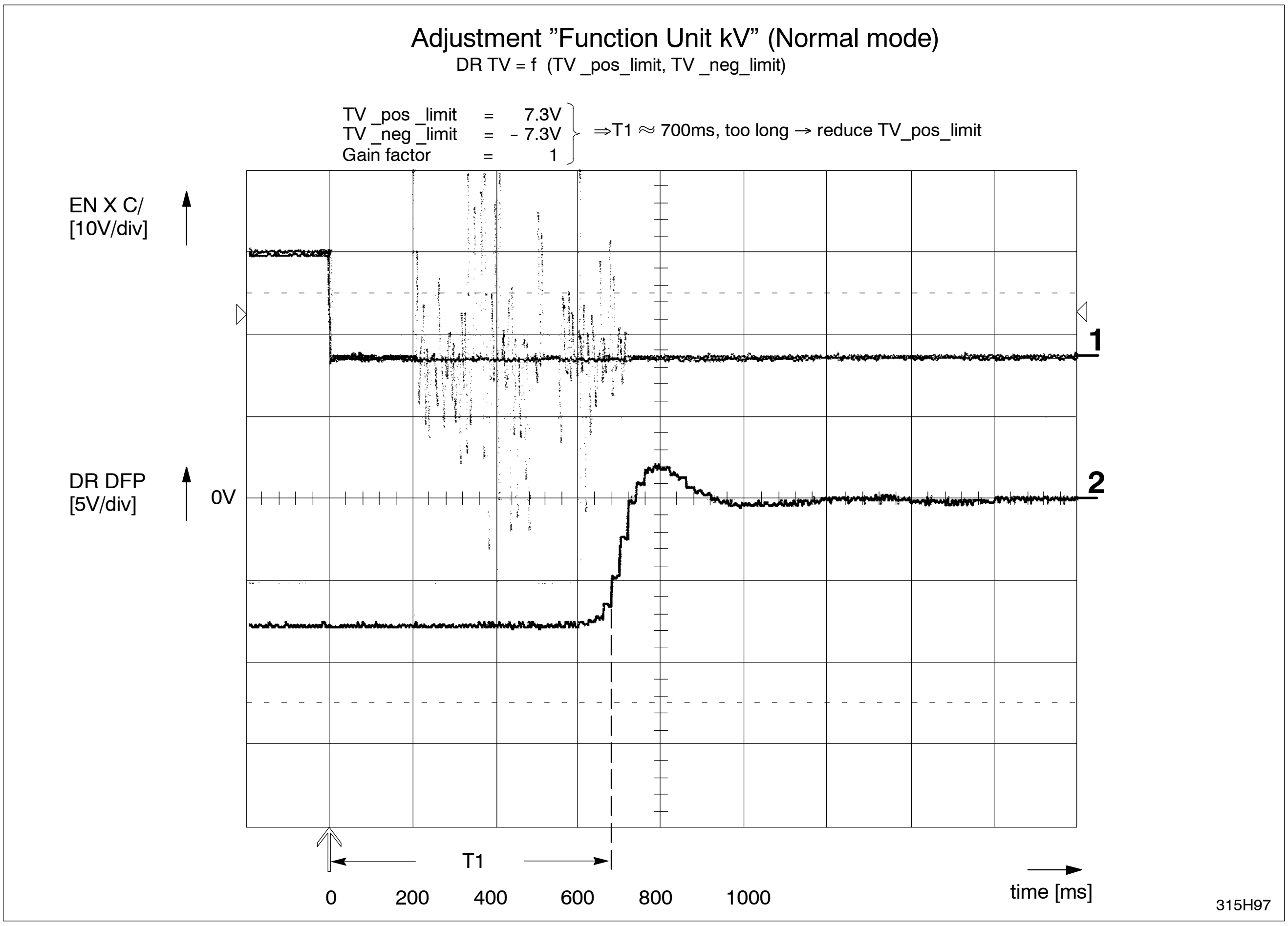
- 9” I.I. format
- Filter in the path of radiation: 1.5mmCu + 20mmAl ==> 74kV/ 2.2mA

First reference oscillogram:

Values adjusted with XRGSCOPE:

```
- TV_pos_limit [V]   :  [ 7.3 ]
- TV_neg_limit [V]   :  [-7.3 ]
- Gain factor        :  [ 1.00]
```

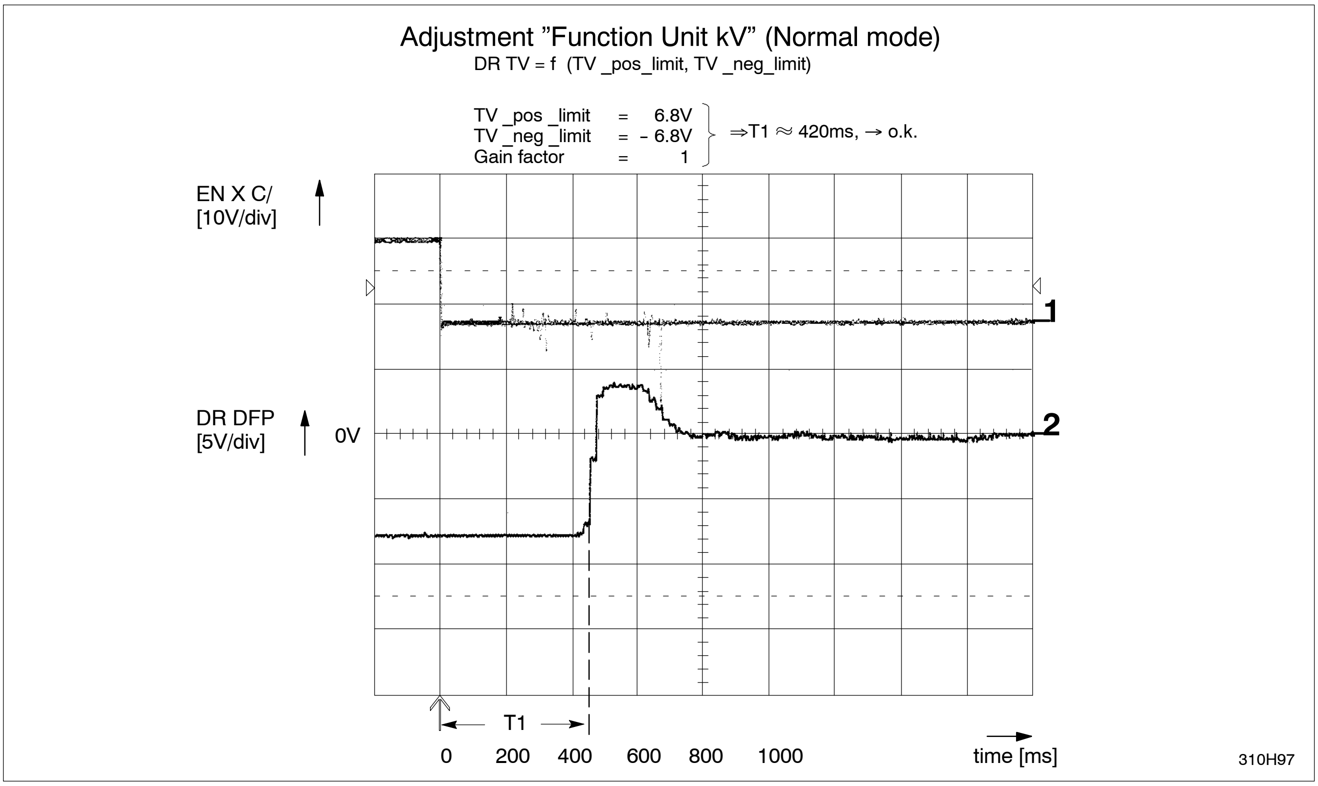
==> T1 ≈ 700ms --> too long --> `reduce TV_pos_limit [V]`

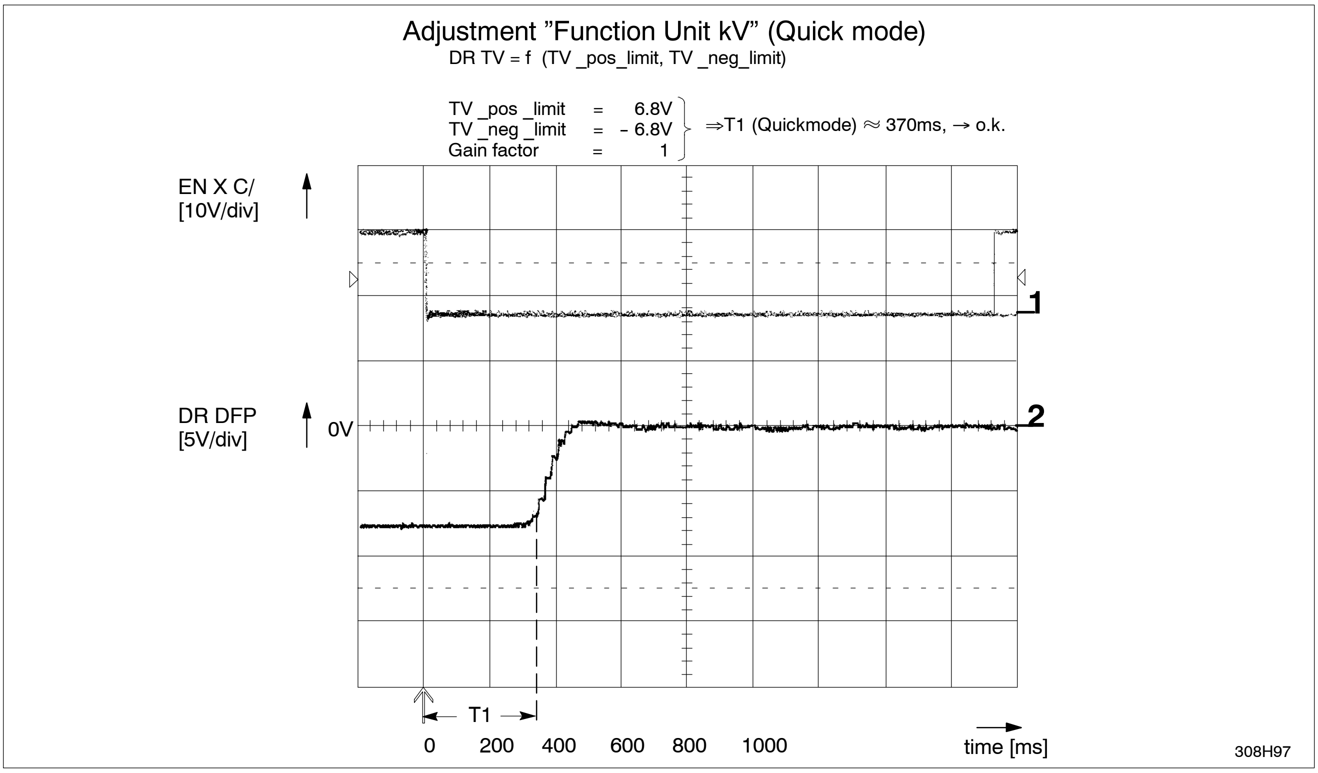


Second reference oscillogram:

Values adjusted with XRGSCOPE:

```
- TV_pos_limit [V]   :  [ 6.8 ]
- TV_neg_limit [V]   :  [-6.8 ]   ==> T1 ≈ 420ms --> o.k.
- Gain factor        :  [ 1.00]   and gain factor can remain as they are
```



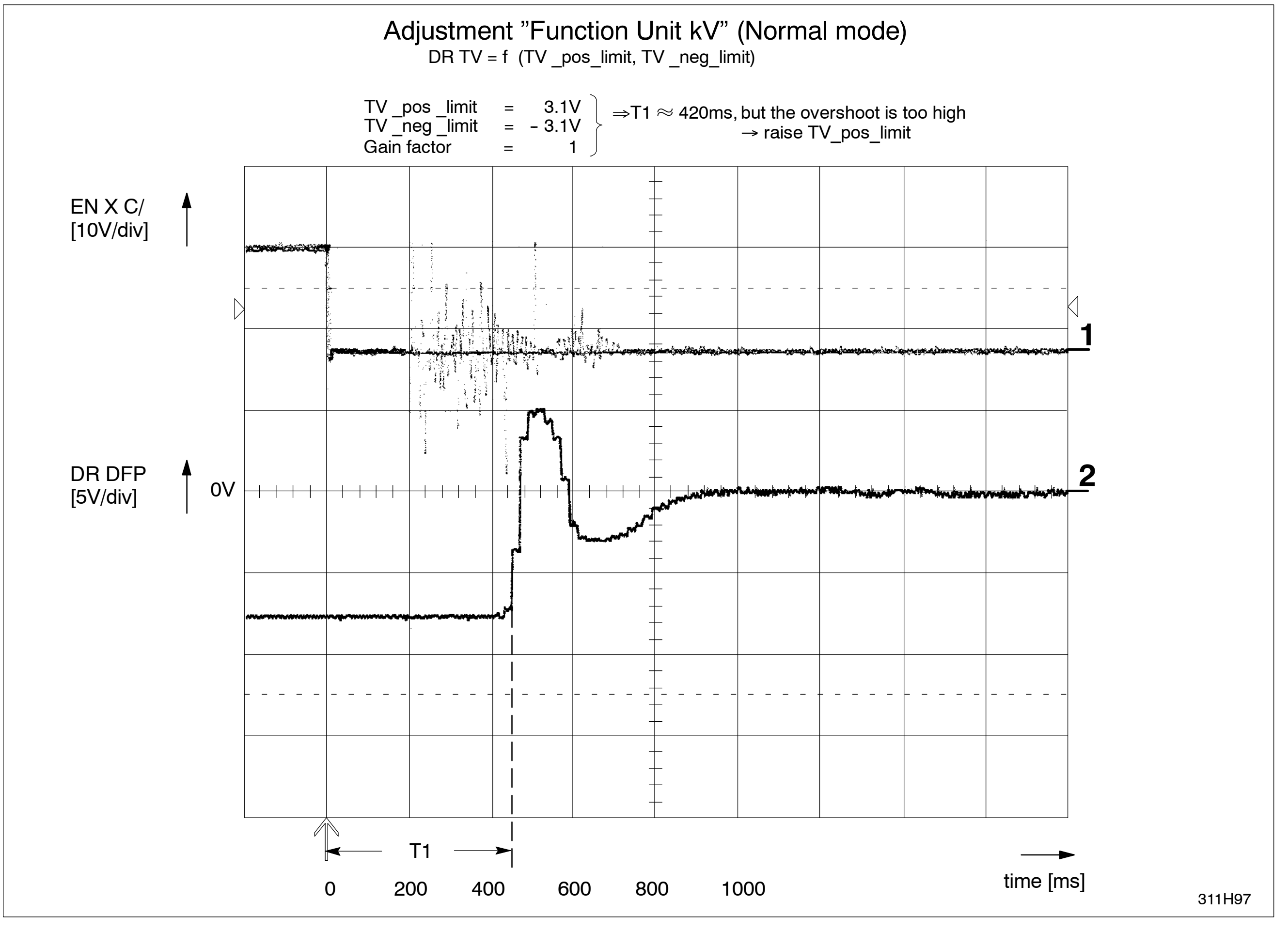


Third reference oscillogram:

Values adjusted with XRGSCOPE:

```
- TV_pos_limit [V]   :  [ 3.1 ]
- TV_neg_limit [V]   :  [-3.1 ]
- Gain factor        :  [ 1.00]
```

==> T1 ≈ 420ms --> o.k., but the overshoot is too high
The TV image flashes!
`--> Raise TV_pos_limit [V]`

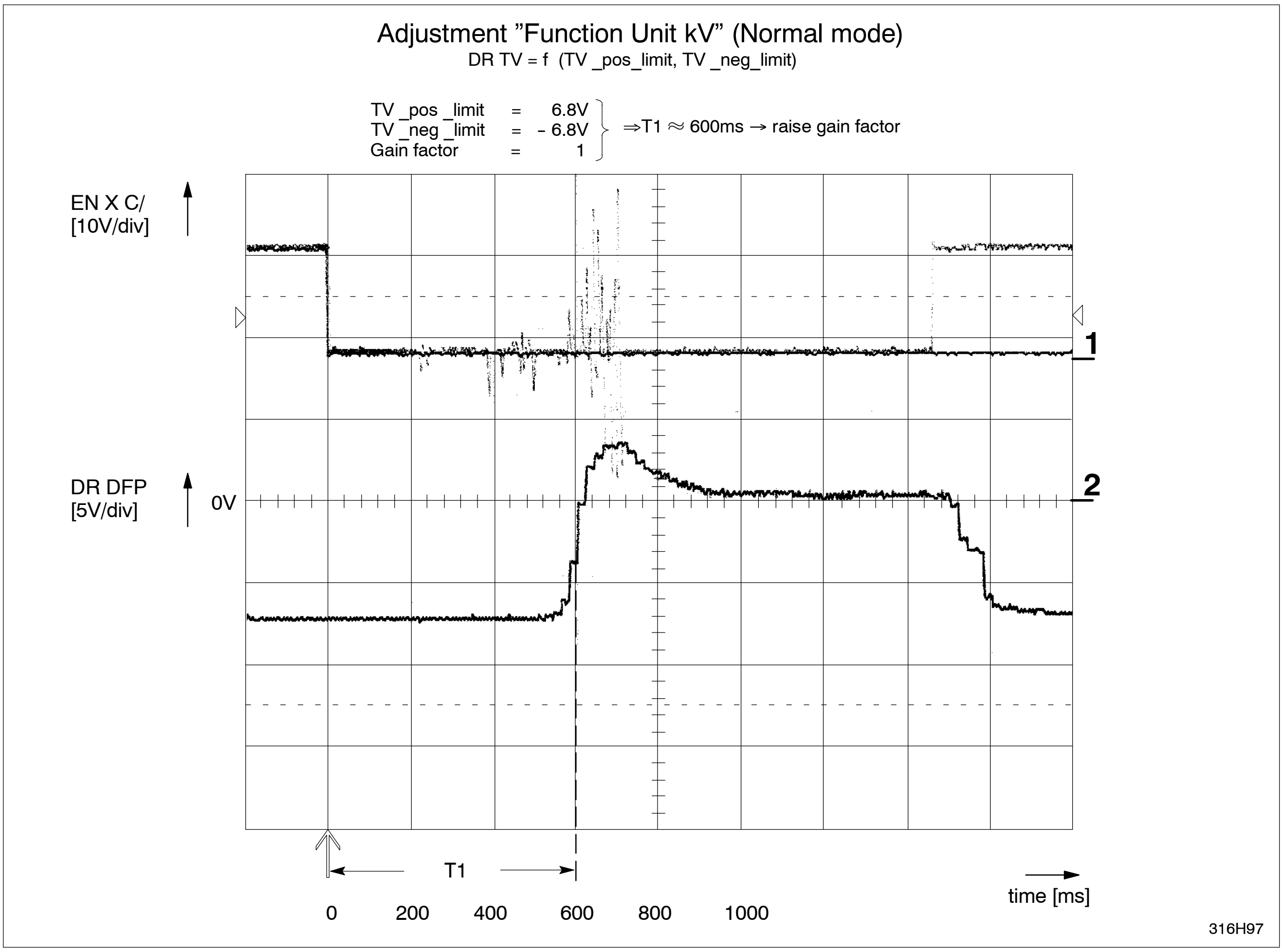


Forth reference oscillogram:

Values adjusted with XRGSCOPE:

```
- TV_pos_limit [V]   :  [  6.8]
- TV_neg_limit [V]   :  [ -6.8]
- Gain factor        :  [0.50 ]
```

==> T1 ≈ 600ms --> too long --> Raise gain factor to 1.00!



4. Maximum patient entrance dose rate: Entrance Dose rate Limiter (EDL)

4.1. Aim

In some countries the maximum patient entrance dose rate must be limited to comply with the respective national regulations, for instance 10R/min = 1.4567μGy/s in the USA.

4.2. Principle

The maximum patient entrance dose is measured with maximum kV. By reducing the maximum power P_max_EDL provided by the generator, the dose rate is reduced until it complies with the national regulations or the individual wish of the user.

Note
*The dose rate reduction programmed via P_max_EDL is effective only when the SID contact (**S**ource **I**mage **D**istance) is switched ON: WB X12:1 DRLM → closed!*

4.3. Alignment

- Cover the I.I. with lead such that with fluoroscopy maximum kV (110kV) are adjusted (protection of the I.I. against excessive radiation).
- Adjust the exam./aux. unit in such a way that the SID contact is closed.
  If necessary, place a shorting plug on decade: WB X12:1 <----> X12:10 (ground).
- Adjust the exam./aux. unit in such a way that the smallest distance between tube and patient is effective.
- Position the dose rate measuring chamber in such a way that it is at the same height where the radiation would enter the patient.
- Switch ON fluoroscopy.
- Reduce/raise **P_max_EDL [W]** with the service software XRGSCOPE until the dose rate is identical with the maximum permissible value:

XRGSCOPE OPTIMUS
  --> Program
    --> Dose rate control
      --> **CONT:**

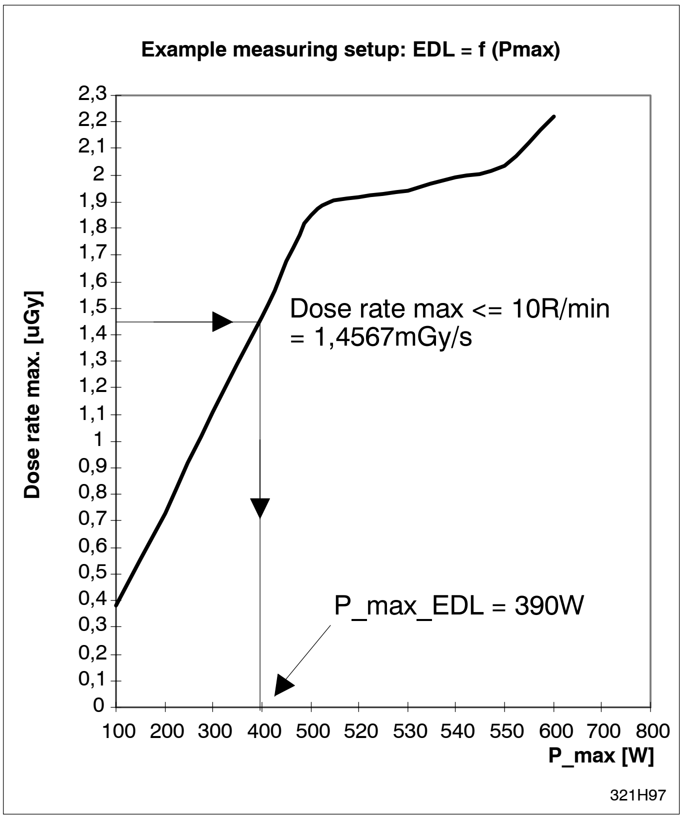
```
+ ---------- CONT_MOD.TDL ---------- +
| scantime_TV [ms]:   [ 20.000] |
| scantime_TV valid:      Yes    |
|                                |
| P_max_EDL [W]:        [ nnn]   |
|                                |
| TV_pos_limit [V]:      [6.8]   |
|                                |
| TV_neg_limit [V]:     [-6.8]   |
| ------------------------------ |
|   < OK >                       |
| ------------------------------ |
```

Range: 0 ... 9000W (250 default)
→ Effective only when SID contact WB X12:1 DRLM is switched ON.

- Note the measuring values:

P_max_EDL: [W]														
Dose rate: [μGy/s]														

Example of a measuring setup:



ACCEPTANCE

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1. Preface 7–1
2. Test equipment 7–1
3. Setup 7–1
4. Test 7–2
5. Exposure counter 7–3

1. Preface

The national rules for accepting an X-ray system are very different. Therefore in the following an example is given for checking the generator in the USA.

OPTIMUS generators are factory-calibrated and checked for compliance with the parameter readout tolerances as stated in the relevant Operator's Manuals.

Provided that these generators are installed and set to work in accordance with the Installation Manuals, only the following limited field compliance testing is required.

2. Test equipment

- Keithley voltage divider model No. 35080 with filter packs 32867C, 5C, 9C or equivalent.
- Oscilloscope (storage)
- Digital mA, mAs meter.

Note

Do not start test until generator has been switched ON for at least one hour.

Direct (invasive) kVp measurements on OPTIMUS generators with HV divider tanks normally available to the field service organization are not permitted.

Measurements of kV using instruments other than the Keithley instrument may lead to larger measuring tolerances. The causes are to be found in the specific frequency response and transient response of each test instrument.

3. Setup

- Switch OFF generator and also switch OFF mains.
  Disconnect breaker to system.
- Connect digital mA meter as per instructions in the relevant Service Manual.
- Set up the Keithley voltage divider complete with the appropriate filter as per Keithley Instructions Manual No. 3294 OIM.
- Connect the oscilloscope to the Keithley divider.

  Note

  Make sure that the oscilloscope has been calibrated with the aid of the Keithley divider as described in the Keithley Instructions Manual before starting any testing (par. 3.6. Internal Calibration).

- Calculate rejection limits based on the exposure parameter "Specification Limits" shown in the table below.

  The "Specification Limits" are based on the actual tolerances as listed in the generator Operator's Manuals.
  These "Specification Limits" must be restricted to include the actual measuring instrument error.
  See also section 6, chapter 3.2 of the "COMPREHENSIVE COMPLIANCE TESTING MANUAL", No. 4535 800 2034x. regarding how to calculate rejection limits.

4. Test

- Switch the system ON.
- Measure the mains voltage on ENF1.

Reference voltage: Mains voltage programmed ±10%

Actual values:
L1 – L2: V

L1 – L3: V

L2 – L3: V

- Select the largest focus.
- Release exposures according to the table below and compare the values measured with the reference values.

Technique	Parameter	Reference range	Measured value	Corrected value
3-knob technique	81kV ±5% ±1kV	76 ... 86kV	.... kV	—
	250mA ±5% ±0.5mA	237 ... 263mA	.... mA	.... mA
	100ms ±5% ±0.5ms	94.5 ... 105.5ms	.... ms	—
2-knob technique	125kV ±5% ±1kV	118 ... 132kV	.... kV	—
	80mAs ±3% ±0.5mAs	77.1 ... 82.9mAs	.... mAs	.... mAs

Owing to an offset current in the measuring circuit of the HV generator the measured values for mA / mAs must be adjusted using the following formulas:

$$I_{corrected}\ [mA] = I_{measured}\ [mA] - \frac{U\ [kV]}{R_{calc}\ [M\Omega]}$$

Offset ≈ 0.2 ... 0.75mA

$$Q_{corrected}\ [mAs] = Q_{measured}\ [mAs] - \frac{U\ [kV] \times t\ [s]}{R_{calc}\ [M\Omega]} - \underbrace{\frac{4.55\ [nF] \times U\ [kV]}{1000}}_{\text{Cable charge for 20m HV cable}}$$

R_{calc} = calculated measuring circuit resistance.
Typical value: ≈ 200MΩ
Read out R_{calc} via service menu: FU_MA/ FAULT FIND/ **READ I_e CORRECTIONS**

Focus assignment:

Focus 1	=	tube 1	large focus
2	=	tube 1	small focus
3	=	tube 2	large focus
4	=	tube 2	small focus
5	=	tube 3	large focus
6	=	tube 3	small focus

t = exposure time according to desk display

5. Exposure counter

Before handing over the generator to the customer, read the exposure counter.
Use menu:
ACCEPT/ INSPECT/ TUBE STATISTIC/ TUBE 1 ... 3 STATISTIC/ **SHOW TUBE STATISTIC**
Record the figure in the table below.

Tube load statistic variable	Unit	Tube1	Tube 2	Tube 3
Reset date	dd.mm.yy			
Last update	dd.mm.yy			
Preparation time large focus	s			
Preparation time small focus	s			
Preparation time vario focus	s			
Preparation counter large focus	1			
Preparation counter small focus	1			
Preparation counter vario focus	1			
Fluoro time	min			
Fluoro counter	1			
Exposure counter large focus	1			
Exposure counter small focus	1			
Exposure counter vario focus	1			
Overload exposures counter large focus	1			
Overload exposures counter small focus	1			
Overload exposures counter vario focus	1			

The tables should be reset whenever the tubes are being replaced.
Use menu:
ACCEPT/ INSPECT/ TUBE STATISTIC/ TUBE 1 ... 3 STATISTIC/ **RESET TUBE STATISTIC**
Record the figure in the table above.

Explanation:

Reset date / Last update:
Reset date and date of last update of the tube statistic.

Preparation time:
The sum of all preparation times per focus.

Preparation counter:
Counts the occurrences of transition STANDBY or FLUORO to PREPARATION per focus.

Fluoro time:
The sum of all fluoro times.

Fluoro counter:
Counts the fluoro commands.

Exposure counter:
Counts the exposures per focus (including the overload exposures).

Overload exposures counter:
Counts the exposures at overload conditions of the tube.

Field Change Order Checklist

Equipment: . . . . **Type No.:** . . . .

. . . . **Serial No.:** . . . .

. . . . **Installation Date:** . . . .

FCO No.	Implemented		Remarks
	Date	Signature	

FCO No.	Implemented		Remarks
	Date	Signature	

Schematic drawings

Basis

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Block diagram expansions Z1-1.2

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Power supply with mains transformer (WT) Z1-2.2
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EY Dual speed rotor control
9890 000 0268x Z1-13.2

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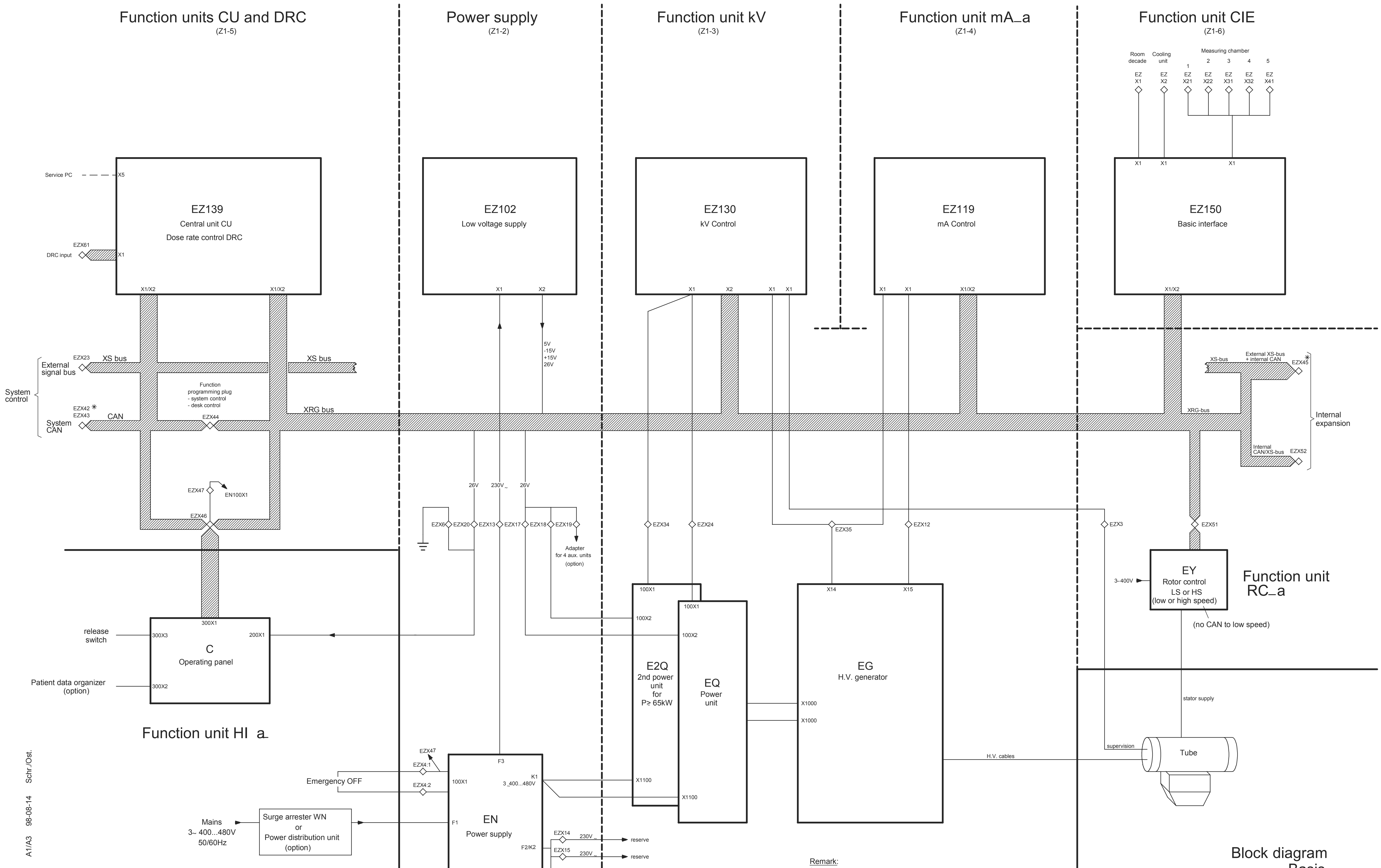
Tube extension WG/1WG/2WG Z1-14.2

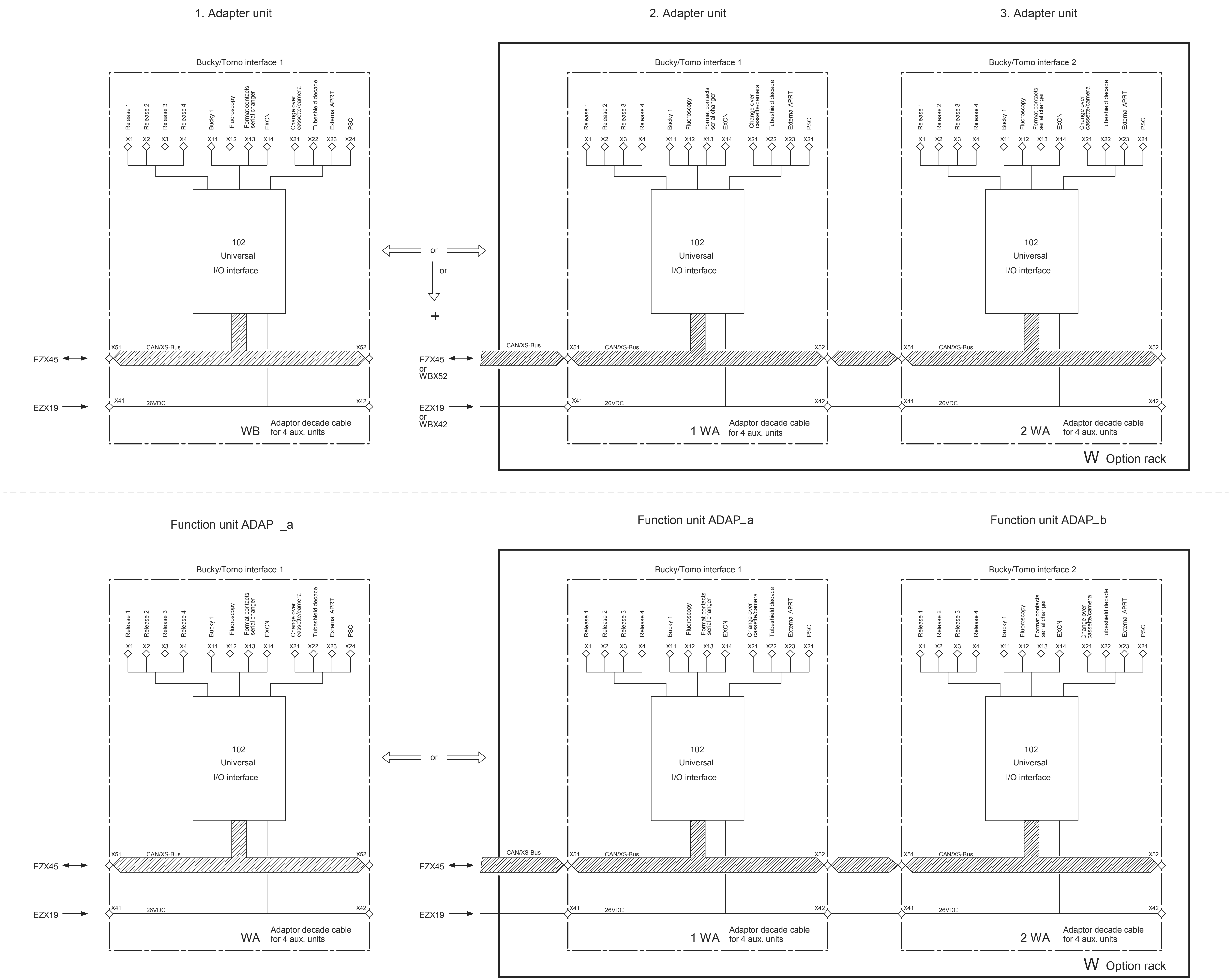
Adapter 4 auxil. units WA/1WA/2WA Z1-15.1
Adapter 4 auxil. units WB Z1-15.2

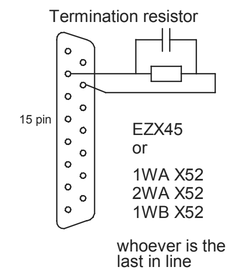


Remark:
* When not used CAN connections EZX42 and EZX45 must be provided with a termination resistor.

Block diagram
Basis

A1/A3 98-08-14 Schr./Ost.



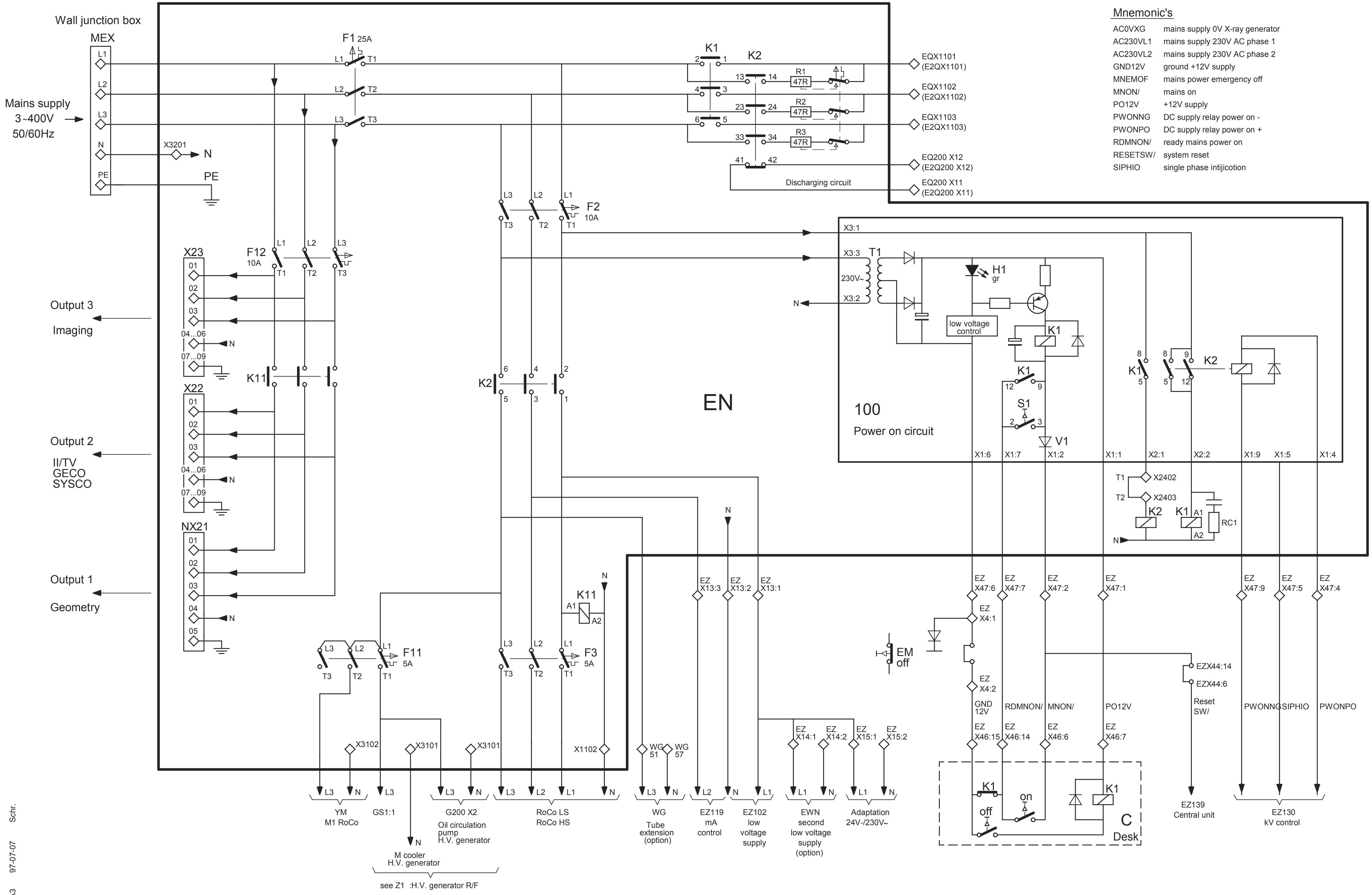


A1/A3 97-09-08 Schr.

Block diagram Expansions

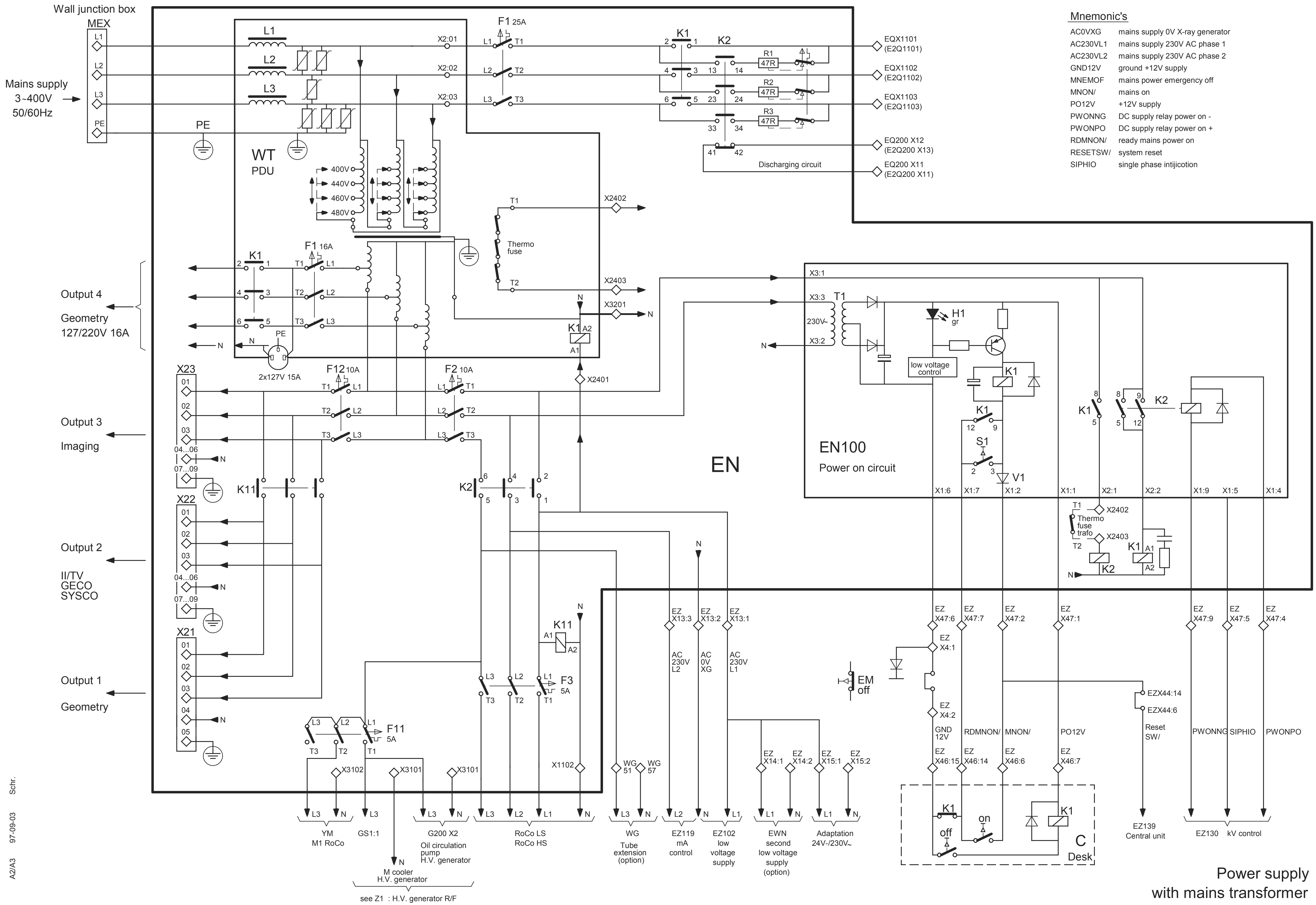
Mnemonic's

AC0VXG	mains supply 0V X-ray generator
AC230VL1	mains supply 230V AC phase 1
AC230VL2	mains supply 230V AC phase 2
GND12V	ground +12V supply
MNEMOF	mains power emergency off
MNON/	mains on
PO12V	+12V supply
PWONNG	DC supply relay power on -
PWONPO	DC supply relay power on +
RDMNON/	ready mains power on
RESETSW/	system reset
SIPHIO	single phase intijicotion



A2/A3 97-07-07 Schr.

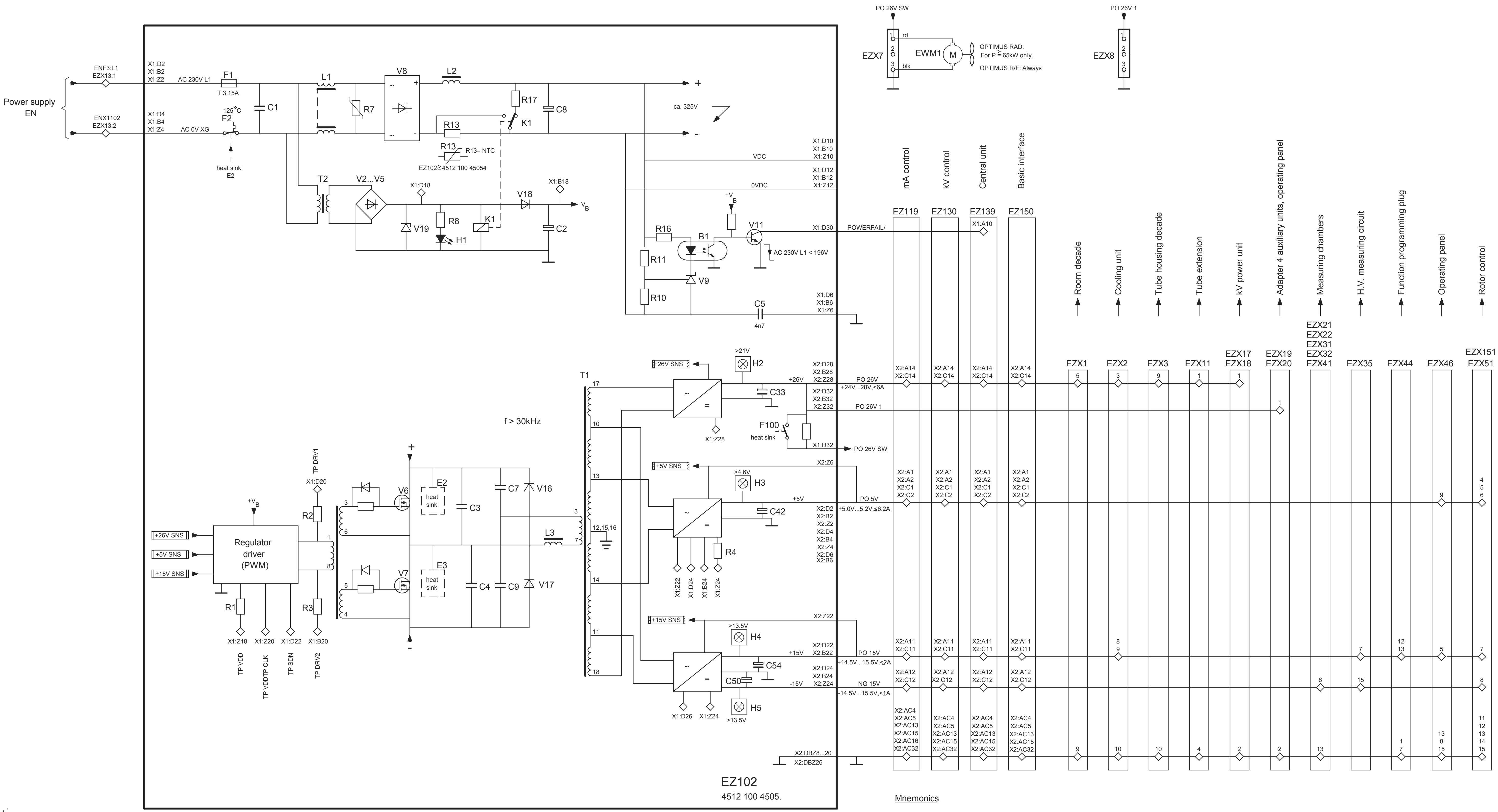
Power supply



Mnemonic's

AC0VXG	mains supply 0V X-ray generator
AC230VL1	mains supply 230V AC phase 1
AC230VL2	mains supply 230V AC phase 2
GND12V	ground +12V supply
MNEMOF	mains power emergency off
MNON/	mains on
PO12V	+12V supply
PWONNG	DC supply relay power on -
PWONPO	DC supply relay power on +
RDMNON/	ready mains power on
RESETSW/	system reset
SIPHIO	single phase intijicotion

Power supply
with mains transformer



Attention!

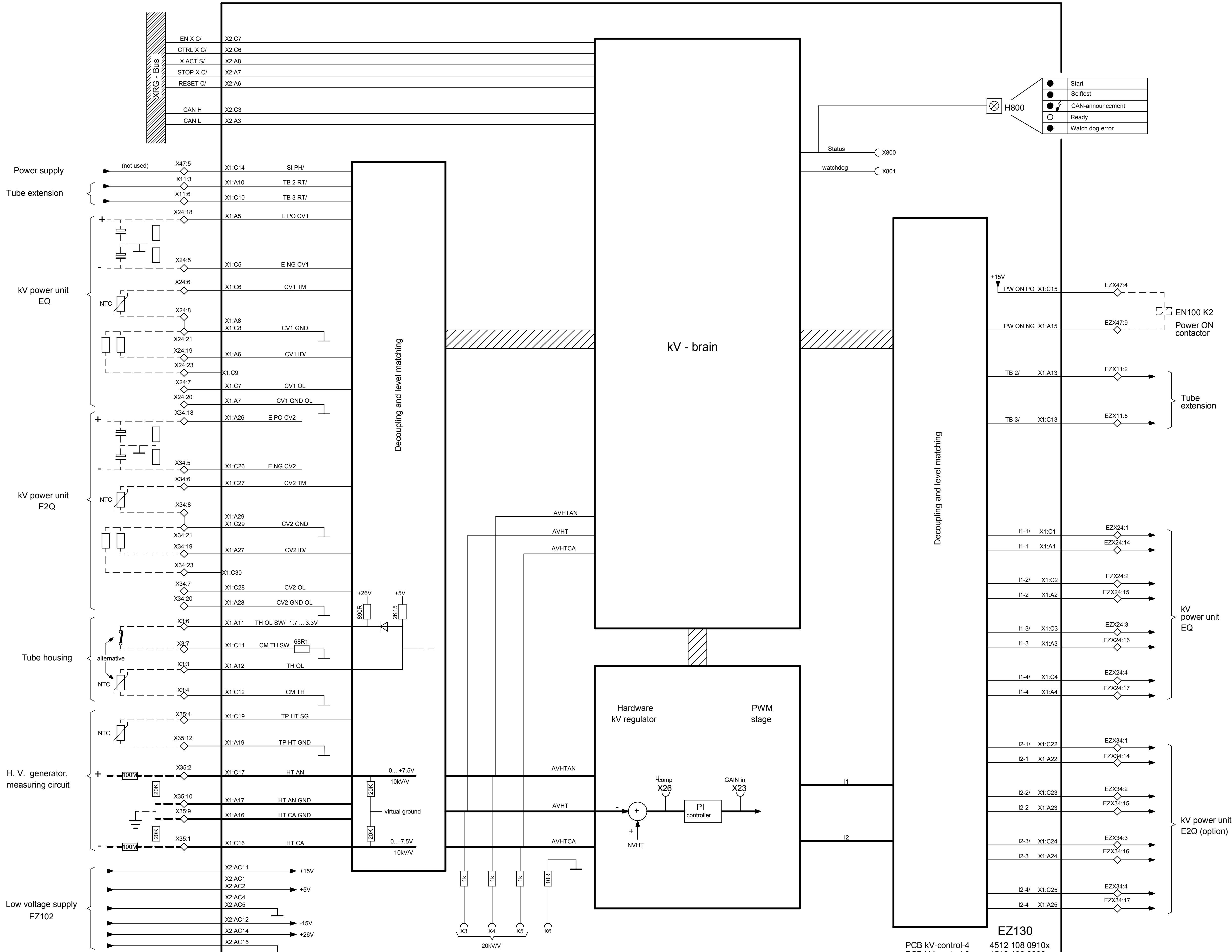
The voltage supplies are short circuit proof.
In case of an error refer to selection "Faultfinding".

Mnemonics

0V DC		TP CLK	test points for internal signals
+5V SNS	5V sense	TP DRV1	
+15V SNS	15V sense	TP DRV2	
+26V SNS	26V sense	TP SDN	
		TP VDD	
AC OV XG	mains supply 0V X-ray generator		
AC 230V L1	mains supply 230V AC phase 1	VDC	
NG 15V	-15V supply		
PO 5V	+5V supply		
PO 15V	+15V supply		
PO 26V	+26V supply		
PO 26V1	+26V supply optional		
PO 26V SW	+26V supply switched		
POWERFAI L/	power failure reset		

A1/A3 99-06-08 Schr.

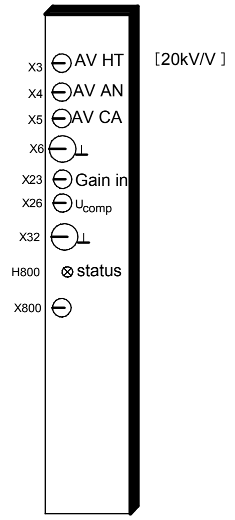
Low voltage power supply



Mnemonics

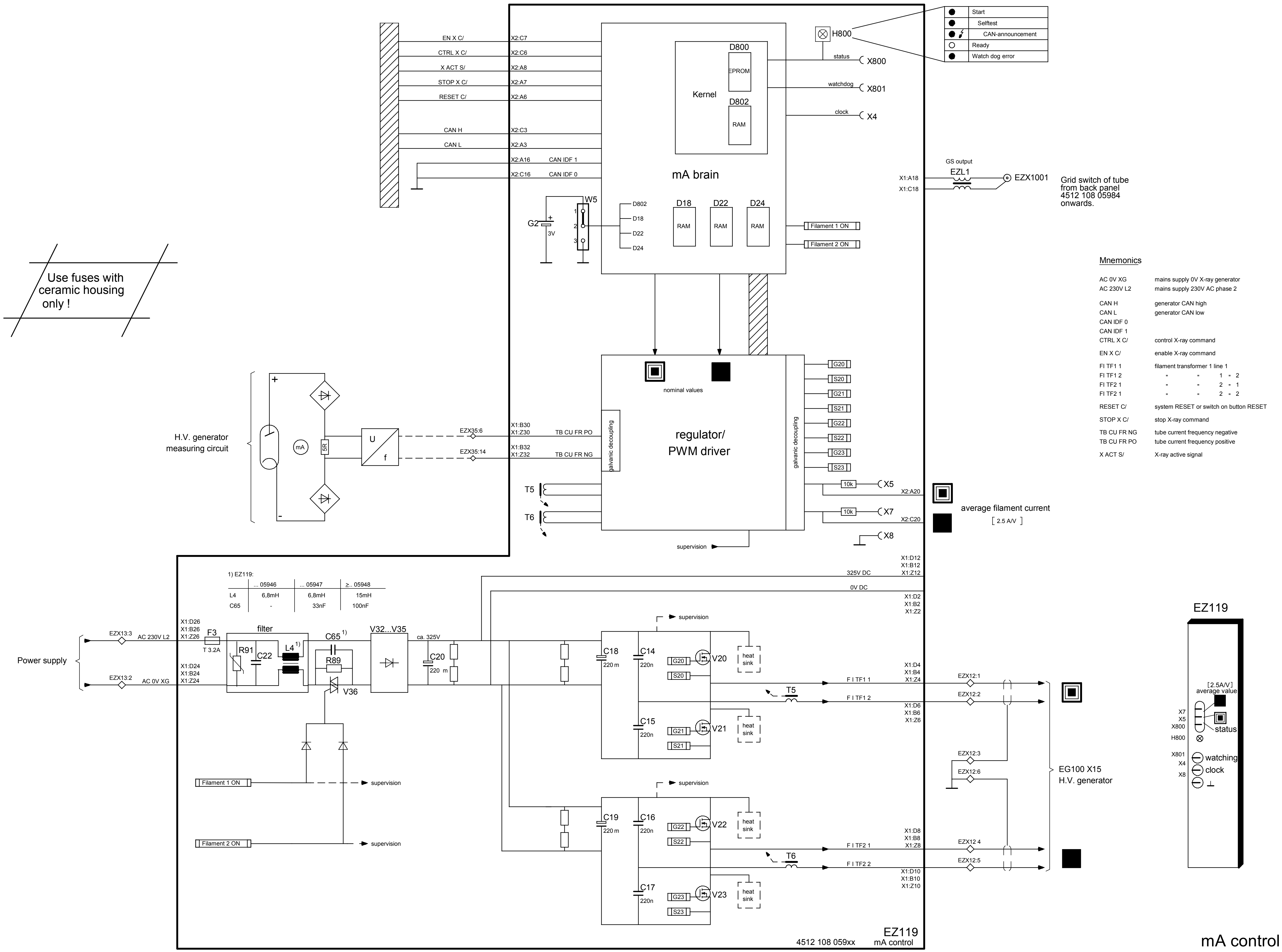
AV HT	high voltage actual value
AV HT AN	high voltage actual value anode side
AV CT CA	high voltage actual value cathode side
CAN H	generator CAN high active
CAN L	generator CAN low active
CM TH	common for thermal sensor
CM TH SW	common for tube housing switch
CTRL X C/	control X-ray command
CV1 EN	converter power part 1 enable
CV2 EN	- - - 2 -
CV1 GND	converter power part 1 ground
CV2 GND	- - - 2 -
CV1 ID	converter power part 1 identification
CV2 ID	2
CV1 GND OL	converter power part 1 ground overload
CV2 GND OL	- - - 2 - -
CV1 OL	converter power part 1 overload
CV2 OL	- - - 2 -
CV1 TM	converter power part 1 temperature
CV2 TM	- - - 2 -
E NG CV1	E value converter power part 1 DC supply negative
E NG CV2	- - - - - 2 - - -
E PO CV1	E value converter power part 1 DC supply positive
E PO CV2	- - - - - 2 - - -
EN X C/	enable X-ray command
HT AN	high voltage anode side actual value
HT AN GND	high voltage anode side ground
HT CA	high voltage cathode side actual value
HT CA GND	high voltage cathode side ground
I1	power part 1
I2	power part 2
I1-1 / I1-1/	IGBT1 power part 1
I1-2 / I1-2/	IGBT2 power part 1
I1-3 / I1-3/	IGBT3 power part 1
I1-4 / I1-4/	IGBT4 power part 1
I2-1 / I2-1/	IGBT1 power part 2
I2-2 / I2-2/	IGBT2 power part 2
I2-3 / I2-3/	IGBT3 power part 2
I2-4 / I2-4/	IGBT4 power part 2
PW ON NG	DC supply relay power on _-
PW ON PO	DC supply relay p[ower on +
RESET C/	RESET Fu
SI PH/	single phase identifier
STOP X C/	stop X-ray command
TB 2/	tube 2
3/	- 3
TB 2 RT/	tube 2 return
TB 3 RT/	- 3 return
TH OL SW	tube housing overload switch
TH OL	tube housing overload
TP HT GND	temperature high tension tank ground
TP HT SG	temperature signal high tension tank
X ACT S/	X-ray active signal

EZ130



kV-control

A1/A3 01-11-13 Schr.

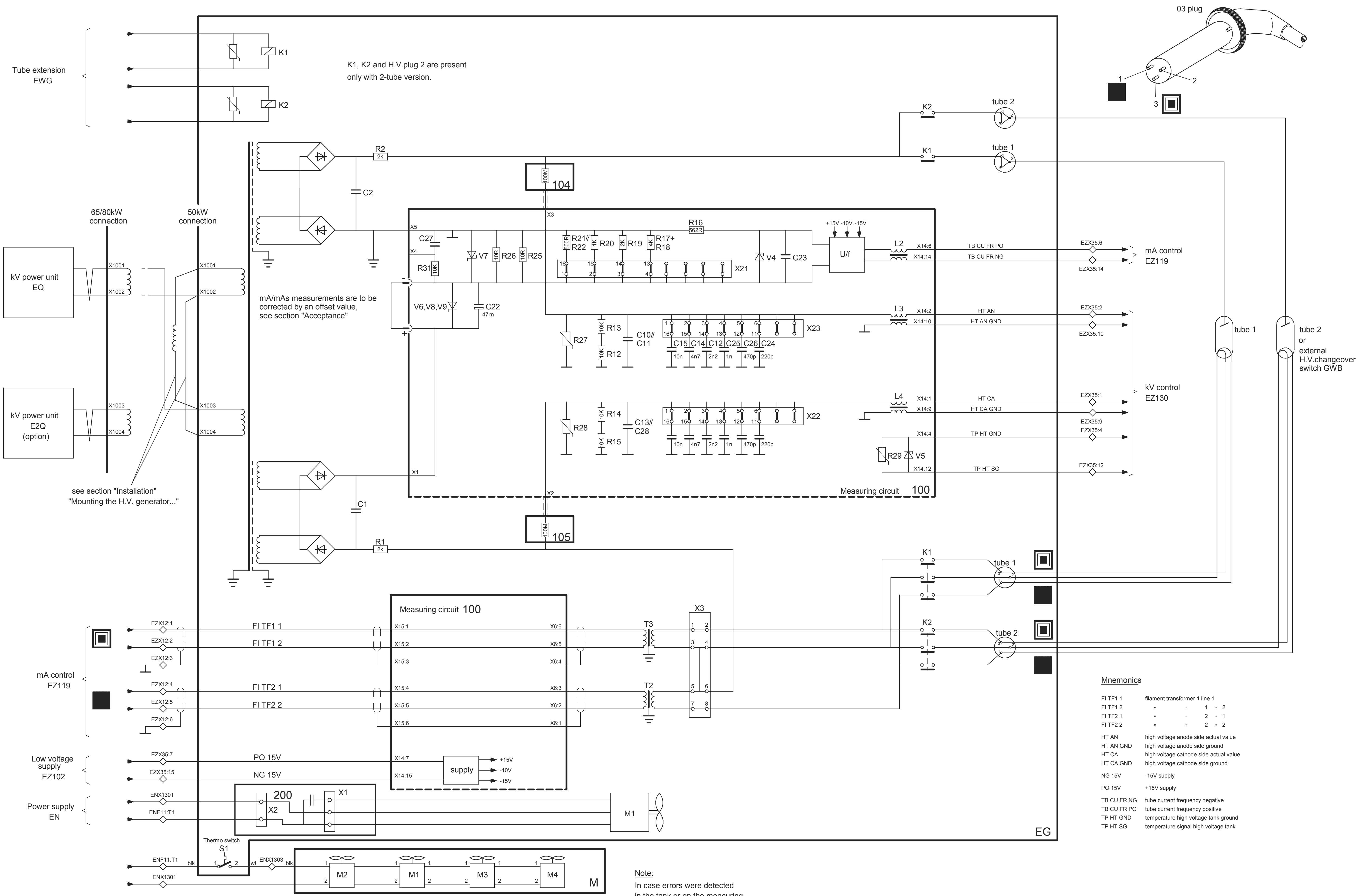


Mnemonics

AC 0V XG	mains supply 0V X-ray generator
AC 230V L2	mains supply 230V AC phase 2
CAN H	generator CAN high
CAN L	generator CAN low
CAN IDF 0	
CAN IDF 1	
CTRL X C/	control X-ray command
EN X C/	enable X-ray command
FI TF1 1	filament transformer 1 line 1
FI TF1 2	- - 1 - 2
FI TF2 1	- - 2 - 1
FI TF2 1	- - 2 - 2
RESET C/	system RESET or switch on button RESET
STOP X C/	stop X-ray command
TB CU FR NG	tube current frequency negative
TB CU FR PO	tube current frequency positive
X ACT S/	X-ray active signal

mA control

A1/A3 01-11-01 Schr.



Note:
In case errors were detected in the tank or on the measuring board, exchange the tank as a whole.

Mnemonics

FI TF1 1 filament transformer 1 line 1
FI TF1 2 " " 1 - 2
FI TF2 1 " " 2 - 1
FI TF2 2 " " 2 - 2

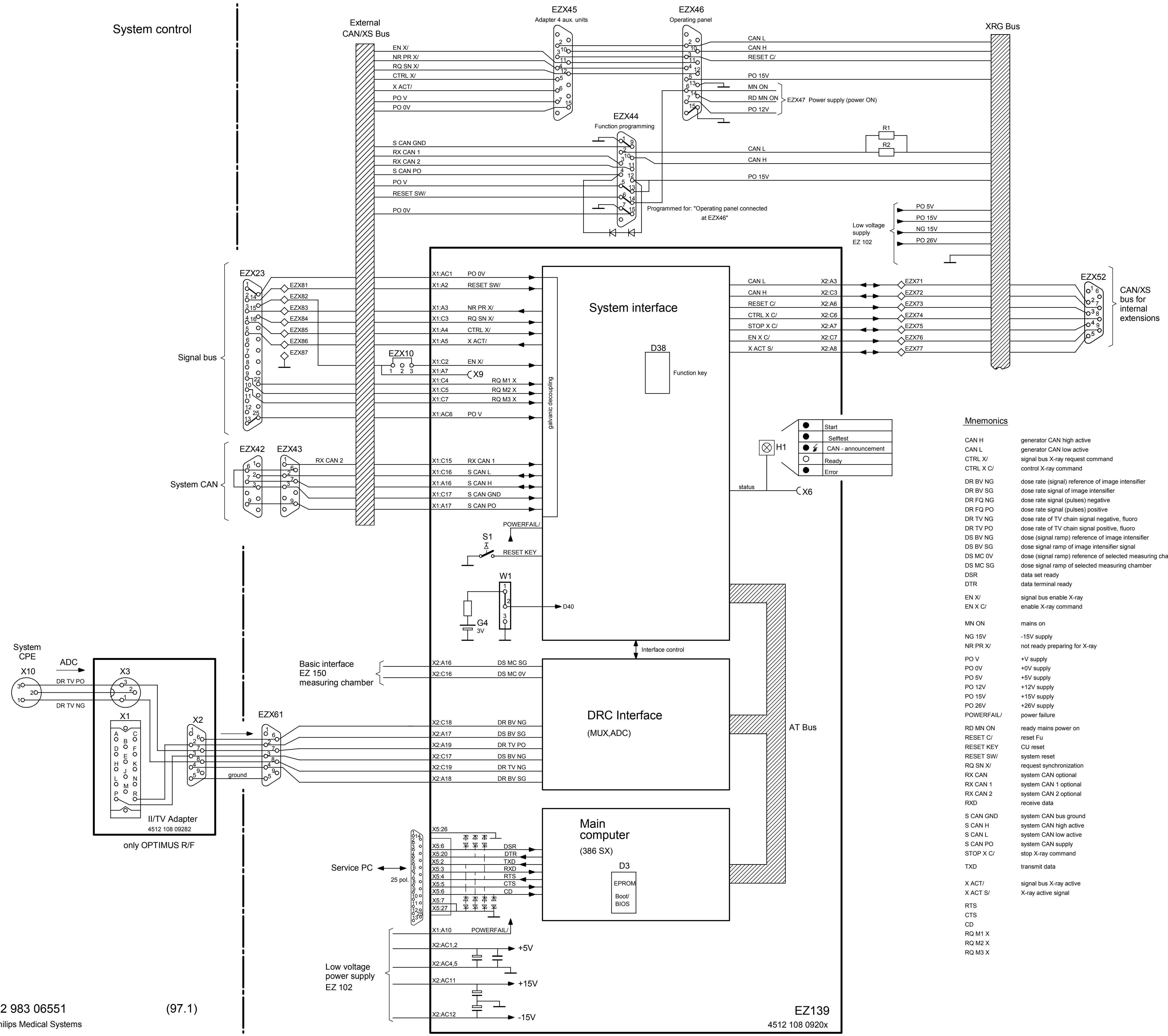
HT AN high voltage anode side actual value
HT AN GND high voltage anode side ground
HT CA high voltage cathode side actual value
HT CA GND high voltage cathode side ground

NG 15V -15V supply

PO 15V +15V supply

TB CU FR NG tube current frequency negative
TB CU FR PO tube current frequency positive
TP HT GND temperature high voltage tank ground
TP HT SG temperature signal high voltage tank

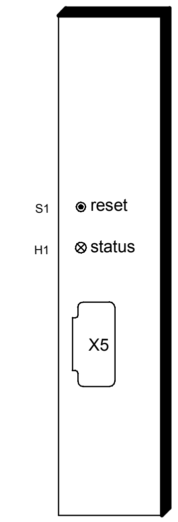
H.V. generator R/F



Mnemonics

CAN H	generator CAN high active
CAN L	generator CAN low active
CTRL X/	signal bus X-ray request command
CTRL X C/	control X-ray command
DR BV NG	dose rate (signal) reference of image intensifier
DR BV SG	dose rate signal of image intensifier
DR FQ NG	dose rate signal (pulses) negative
DR FQ PO	dose rate signal (pulses) positive
DR TV NG	dose rate of TV chain signal negative, fluoro
DR TV PO	dose rate of TV chain signal positive, fluoro
DS BV NG	dose (signal ramp) reference of image intensifier
DS BV SG	dose signal ramp of image intensifier signal
DS MC 0V	dose (signal ramp) reference of selected measuring chamber
DS MC SG	dose signal ramp of selected measuring chamber
DSR	data set ready
DTR	data terminal ready
EN X/	signal bus enable X-ray
EN X C/	enable X-ray command
MN ON	mains on
NG 15V	-15V supply
NR PR X/	not ready preparing for X-ray
PO V	+V supply
PO 0V	+0V supply
PO 5V	+5V supply
PO 12V	+12V supply
PO 15V	+15V supply
PO 26V	+26V supply
POWERFAIL/	power failure
RD MN ON	ready mains power on
RESET C/	reset Fu
RESET KEY	CU reset
RESET SW/	system reset
RQ SN X/	request synchronization
RX CAN	system CAN optional
RX CAN 1	system CAN 1 optional
RX CAN 2	system CAN 2 optional
RXD	receive data
S CAN GND	system CAN bus ground
S CAN H	system CAN high active
S CAN L	system CAN low active
S CAN PO	system CAN supply
STOP X C/	stop X-ray command
TXD	transmit data
X ACT/	signal bus X-ray active
X ACT S/	X-ray active signal
RTS	
CTS	
CD	
RQ M1 X	
RQ M2 X	
RQ M3 X	

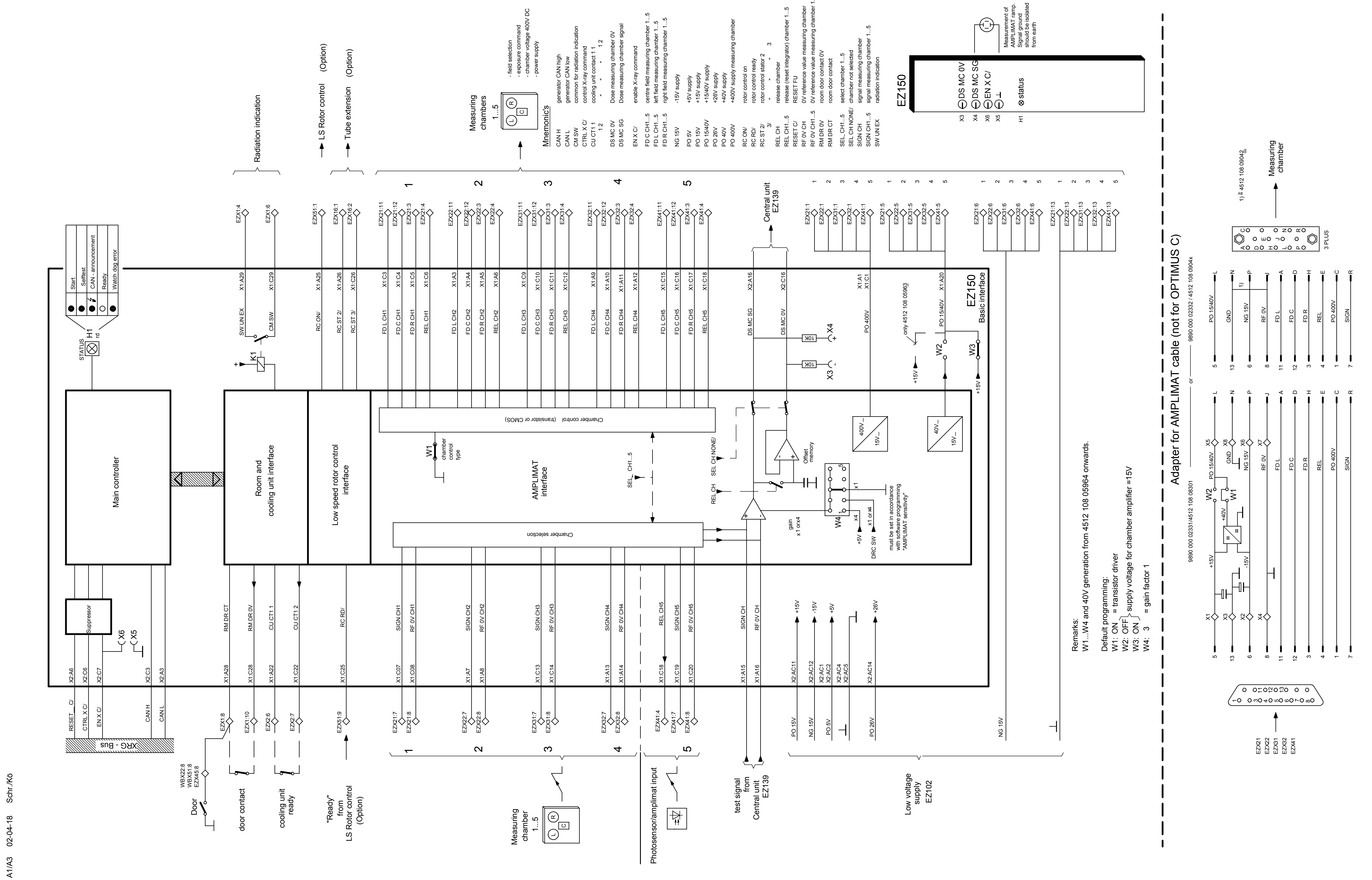
EZ139



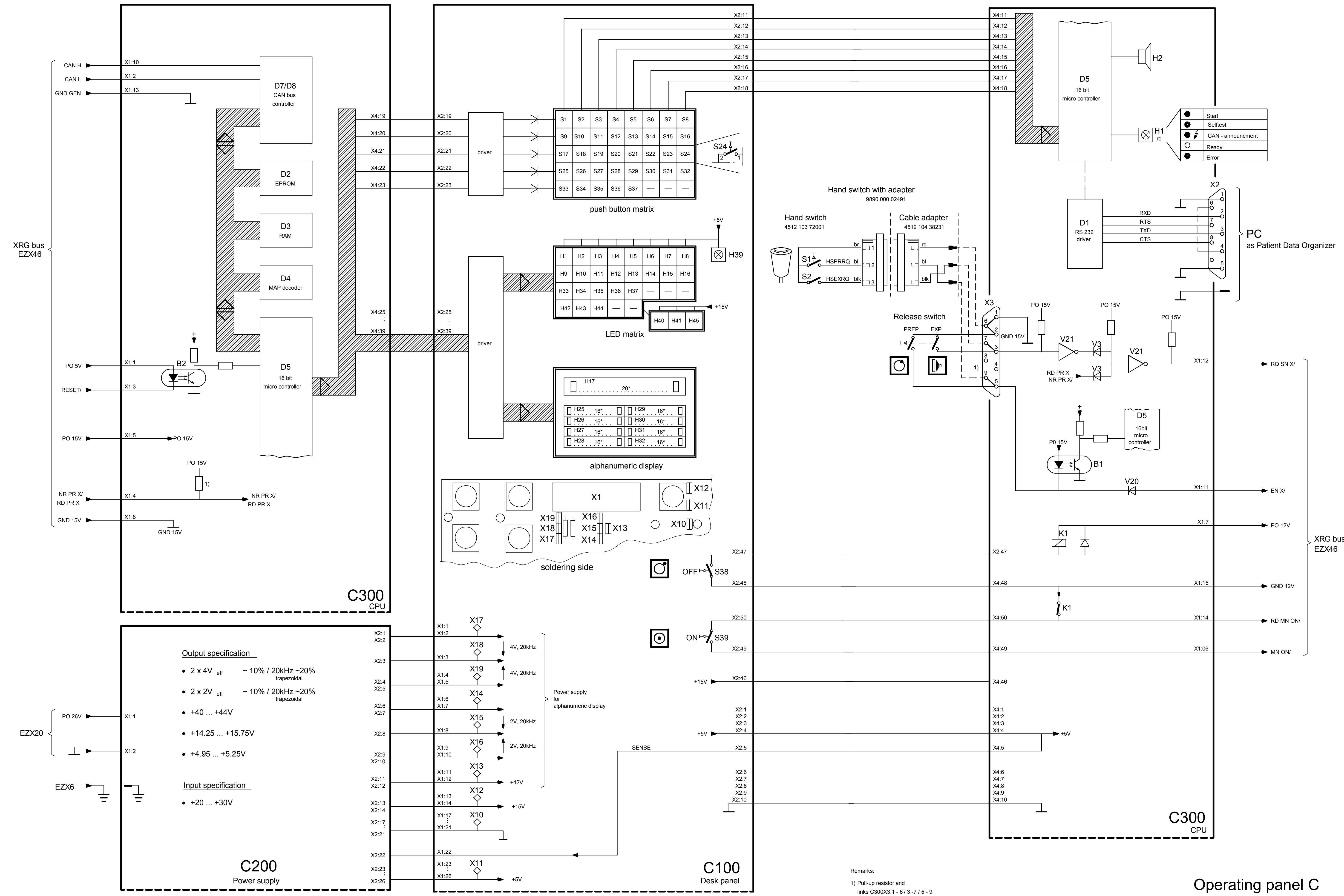
Central unit

A1/A3 99-02-10 Schr.

4512 983 06551 (97.1)



Basic interface



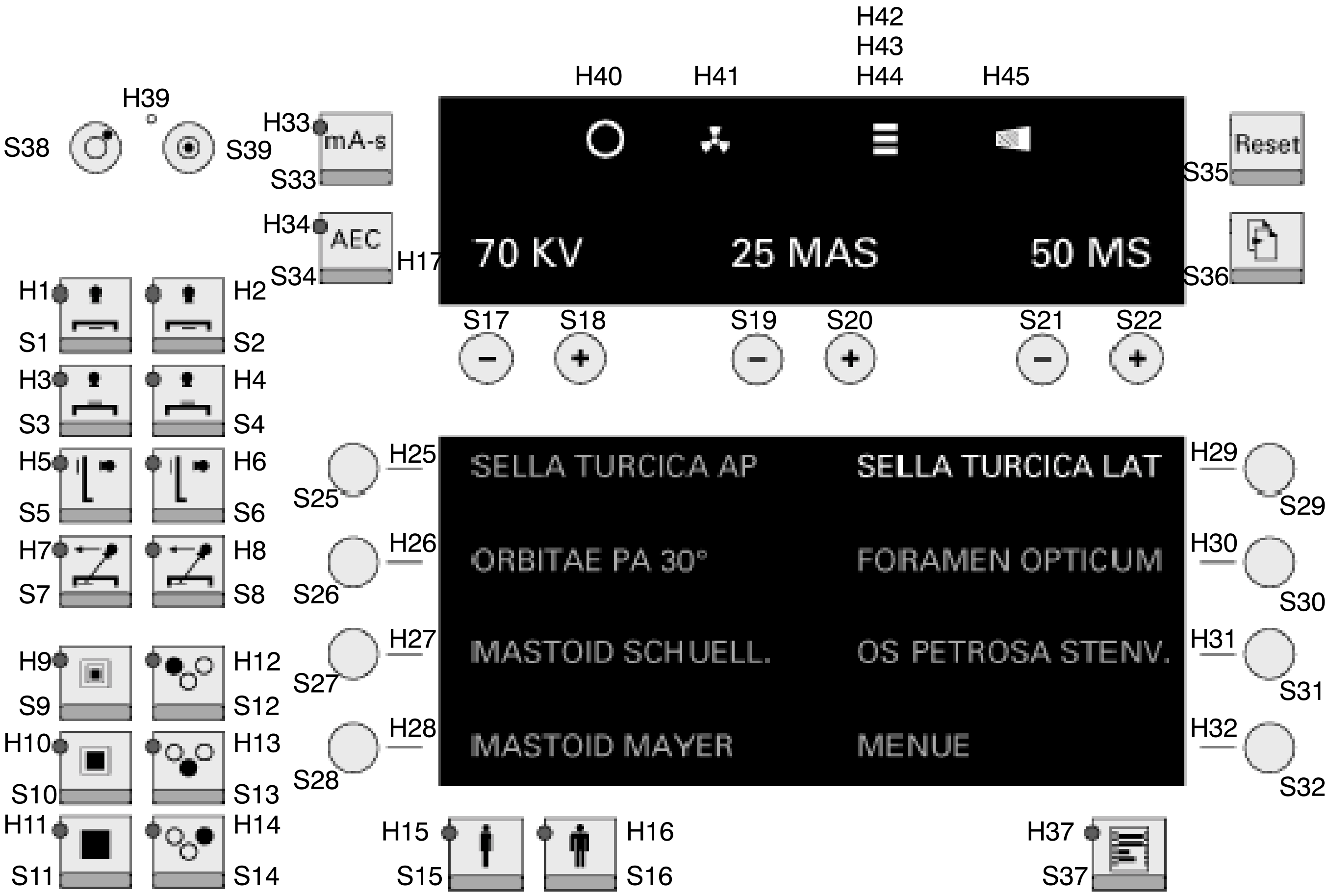
Remarks:

1) Pull-up resistor and links C300X3:1 - 6 / 3 -7 / 5 - 9 from CPU 4512 108 08244 onwards.

A1/A3 02-08-08 Schr.

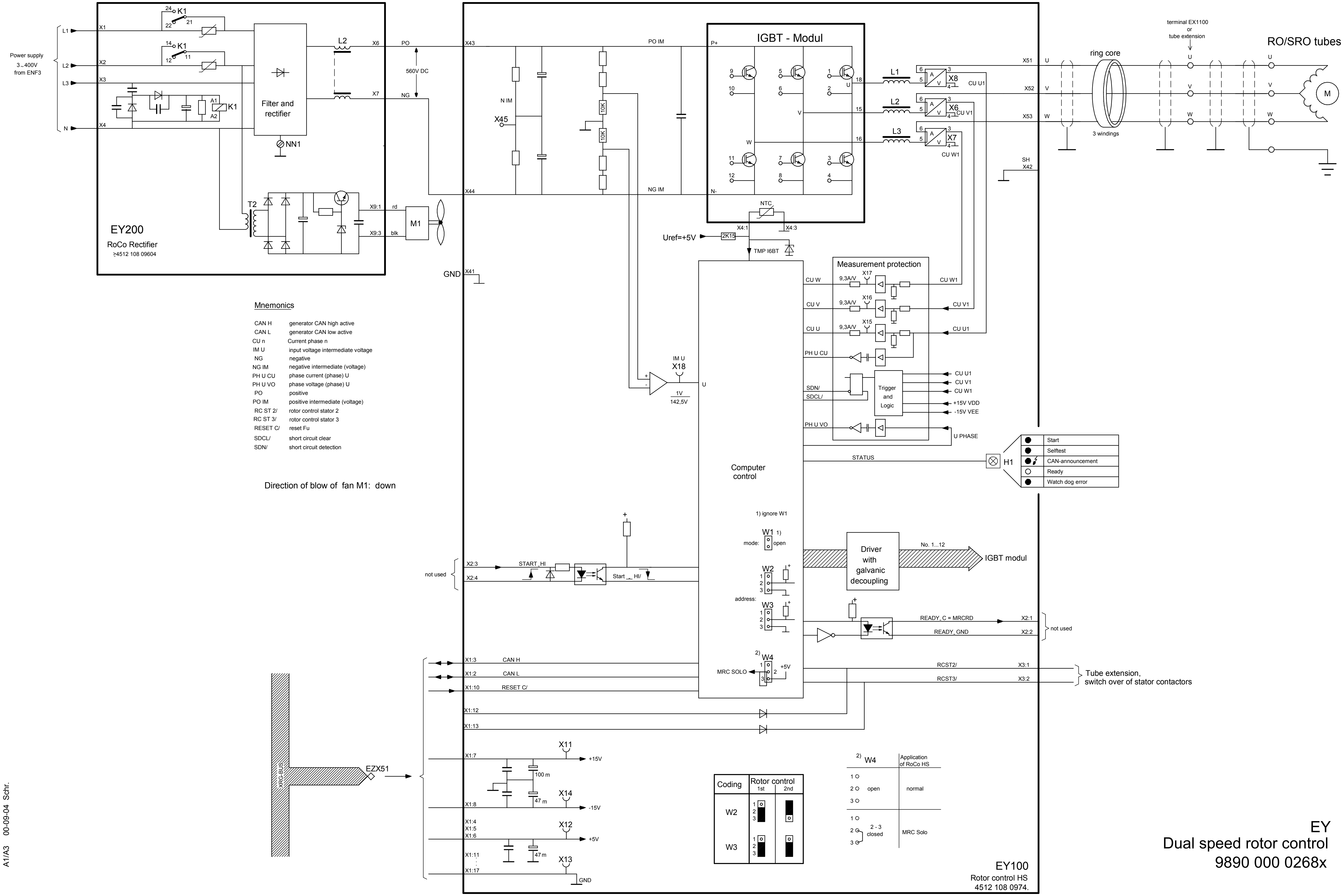
Operating panel C

4512 983 05521 (02.0)



A4 94-06-17 Ost.
optimus_z1-11_2

Button and display arrangement



Mnemonics

CAN H	generator CAN high active
CAN L	generator CAN low active
CU n	Current phase n
IM U	input voltage intermediate voltage
NG	negative
NG IM	negative intermediate (voltage)
PH U CU	phase current (phase) U
PH U VO	phase voltage (phase) U
PO	positive
PO IM	positive intermediate (voltage)
RC ST 2/	rotor control stator 2
RC ST 3/	rotor control stator 3
RESET C/	reset Fu
SDCL/	short circuit clear
SDN/	short circuit detection

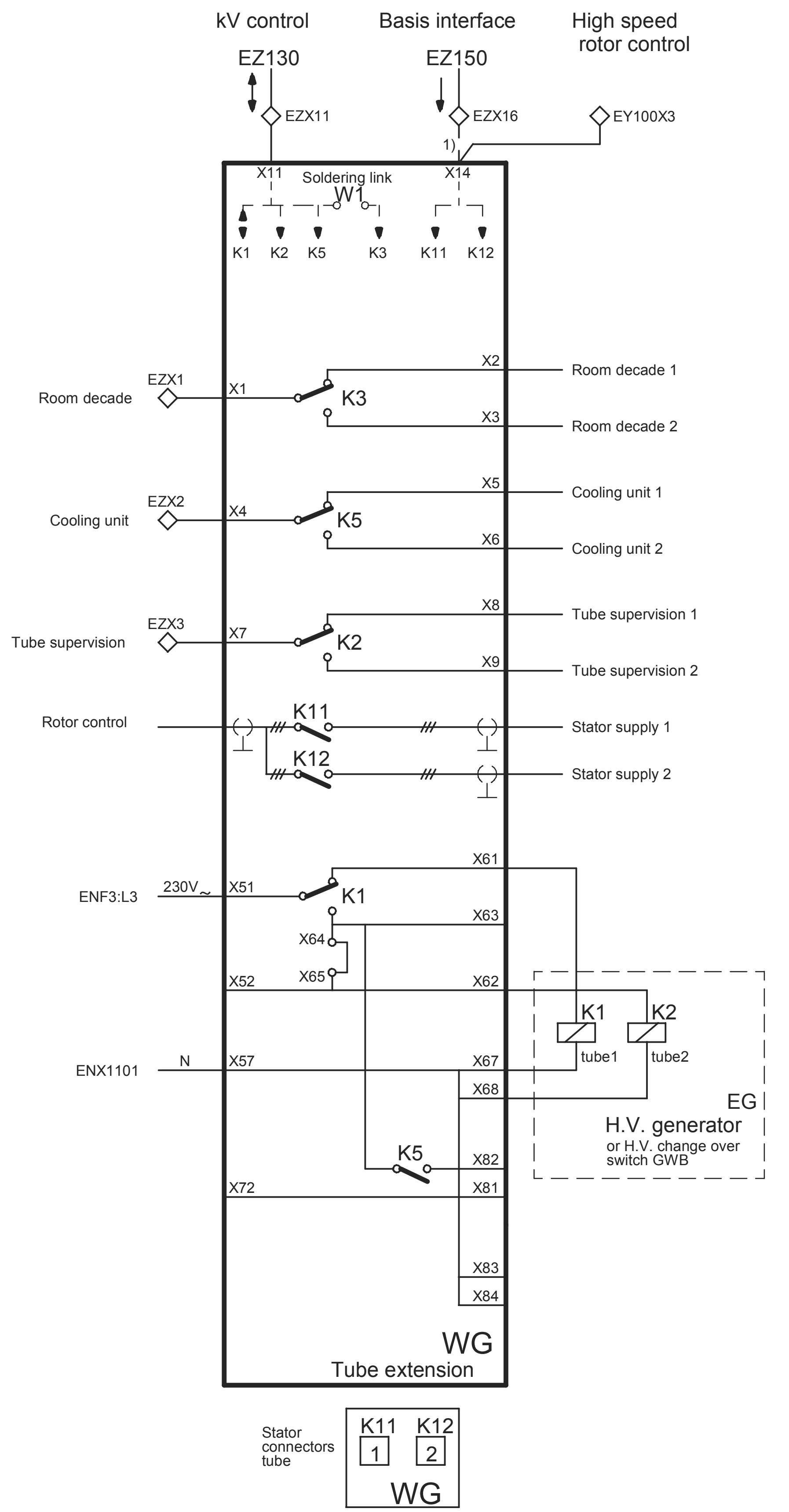
Direction of blow of fan M1: down

EY
Dual speed rotor control
9890 000 0268x

A1/A3 00-09-04 Schr.

Tube extension overview

Tube extension for 2 tubes

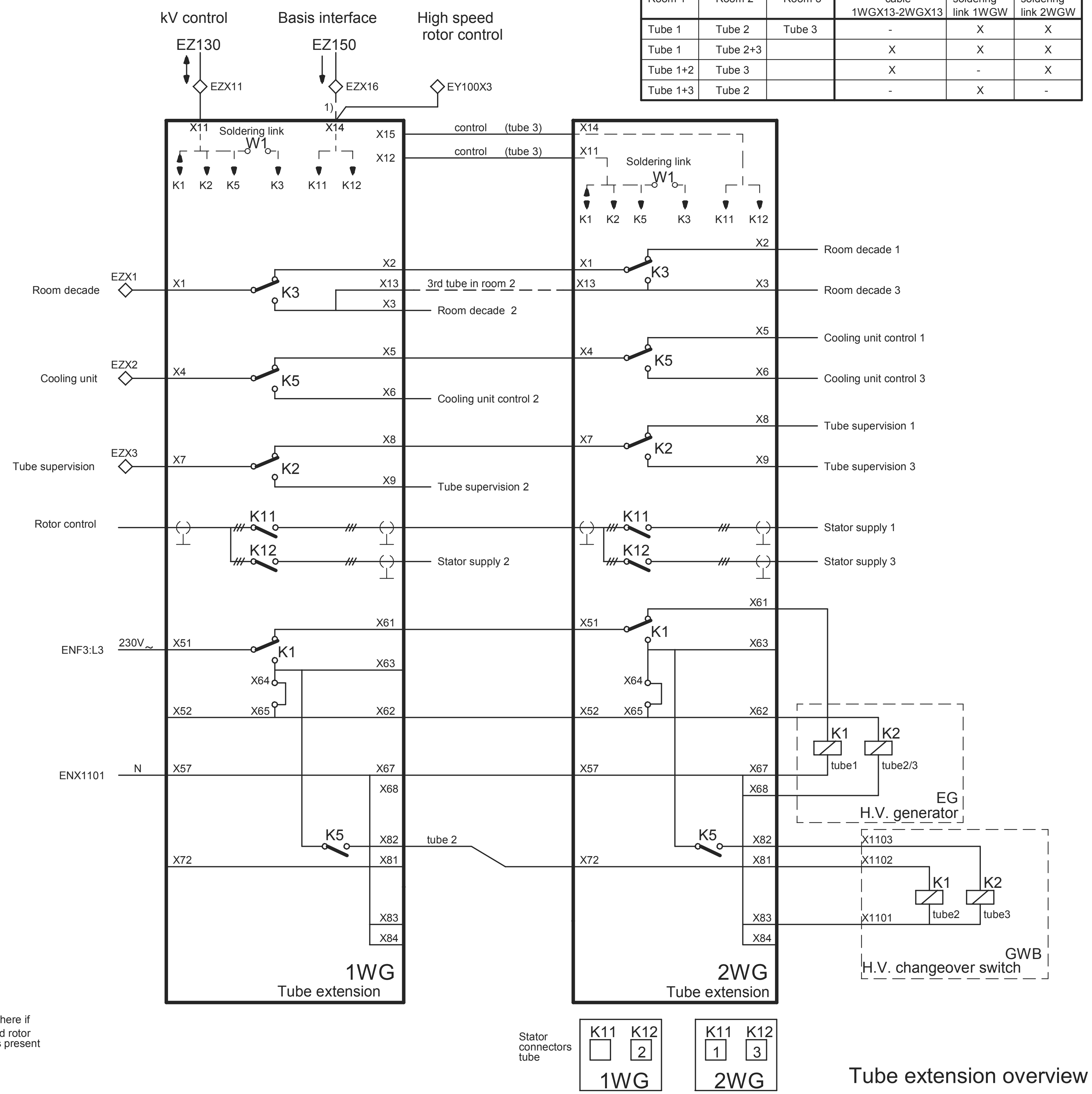


1) Connect here if low speed rotor control is present

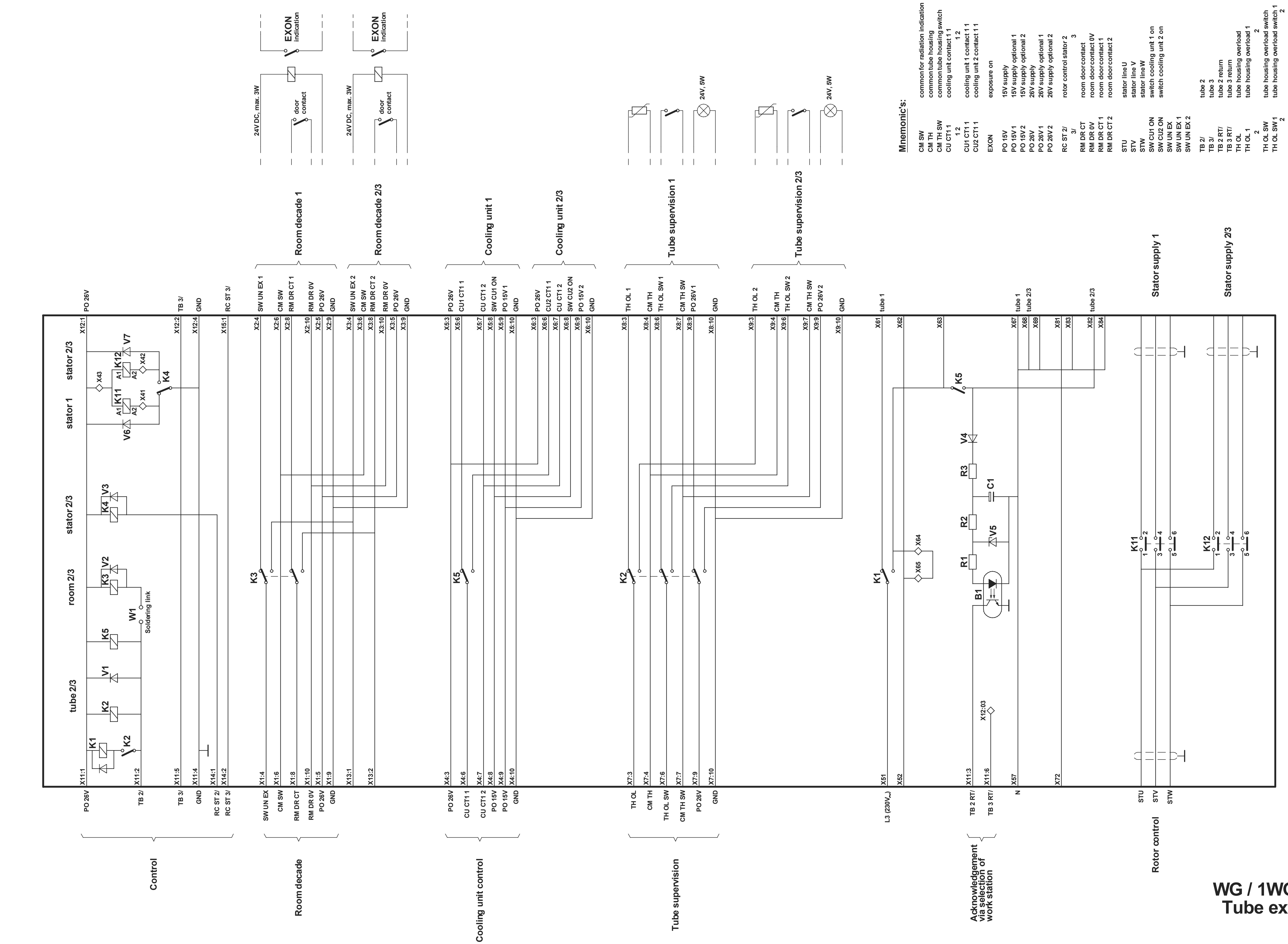
Tube extensions for 3 tubes

Hardware programming

Room 1	Room 2	Room 3	cable 1WGX13-2WGX13	soldering link 1WGW	soldering link 2WGW
Tube 1	Tube 2	Tube 3	-	X	X
Tube 1	Tube 2+3		X	X	X
Tube 1+2	Tube 3		X	-	X
Tube 1+3	Tube 2		-	X	-

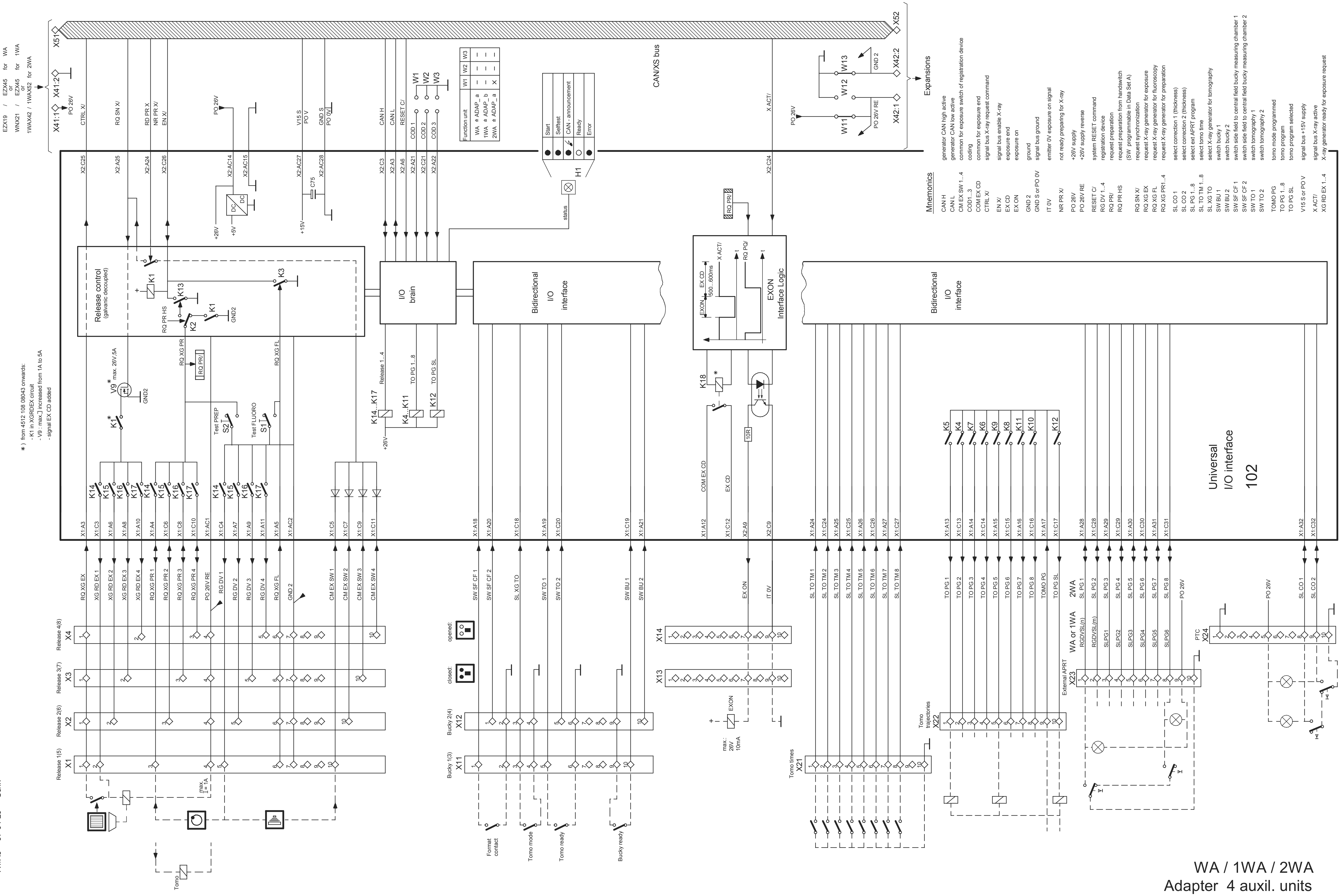


A2/A3 98-08-17 Ost.



A1/A3 97-11-26 Ost.

WG / 1WG / 2WG
Tube extension

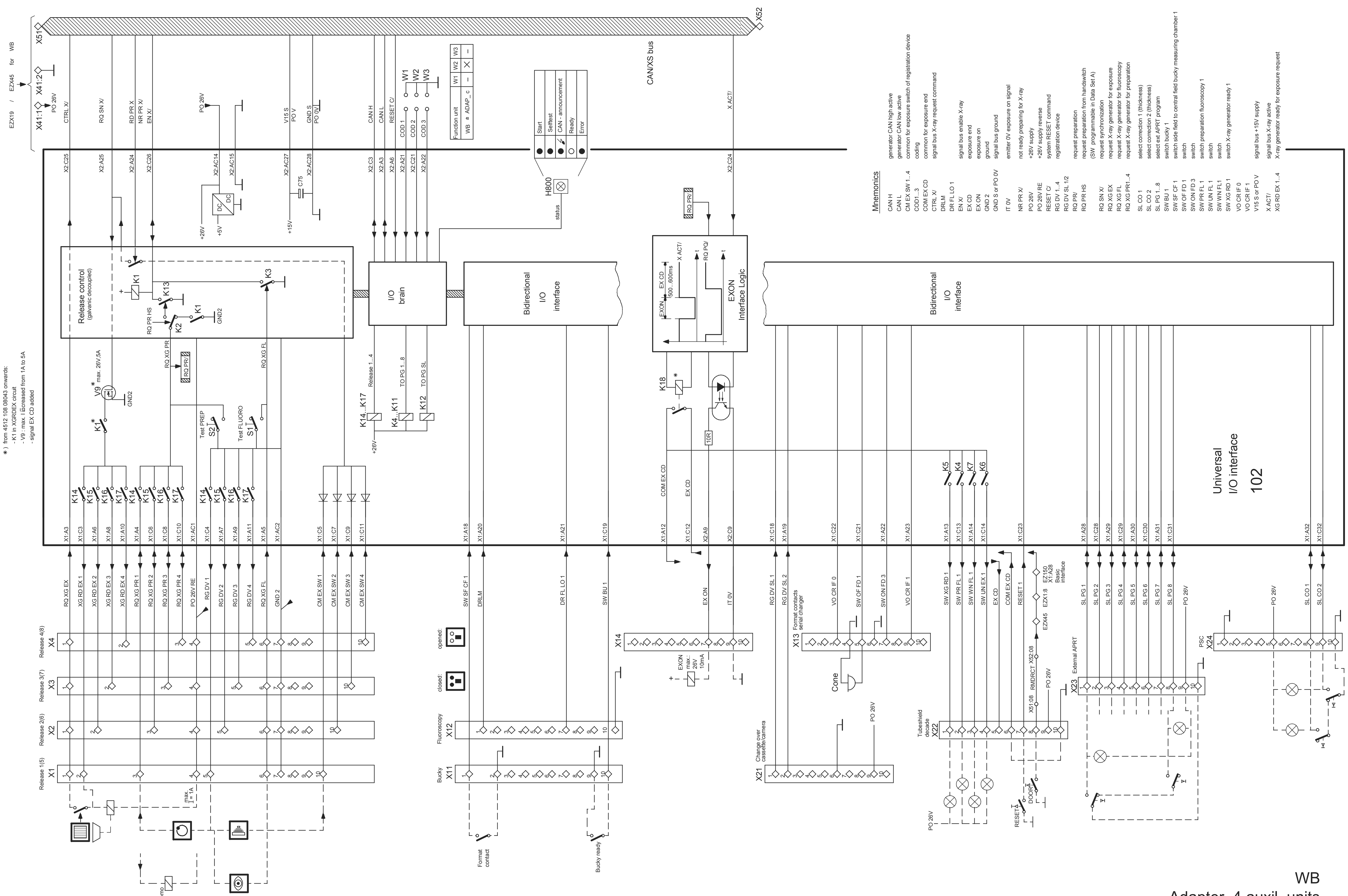


A1/A3 97-04-29 Schr.

WA / 1WA / 2WA
Adapter 4 auxil. units

OPTIMUS R/F

(97.0)



A1/A3 97-09-17 Schr./Ost.

WB
Adapter 4 auxil. units

OPTIMUS R/F

(97.1)

Z1-15.2

Wiring diagrams

Cabinet E Z2–1.0
Cabinet wiring E, 50 kW Z2–1.1
Cabinet wiring E, 65/80 kW Z2–1.2
Earthing diagram E Z2–1.3

Power supply N, 50 kW Z2–2.1.1/.2
Power supply N, 65/80 kW Z2–2.2.1/.2

Backpanel EZ / Basis rack-2 Z 4512 108 0936 . . . . Z2–5.1/.2/.3
Backpanel EZ / Basis rack-2 Z survey of components Z2–5.4

Dual speed rotor control
9890 000 0268x Z2–13

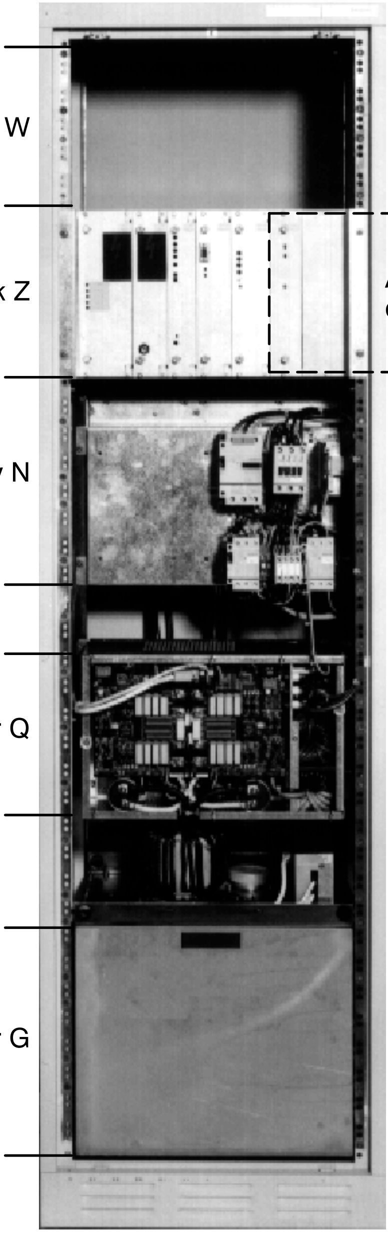
Cabinet wiring: Tube extension WG and air coolers H.V. generator Z2–14.1
Tube extension WG Z2–14.2
Tube extension 1WG/2WG Z2–14.3
Air coolers H.V. generator Z2–14.4

Cabinet wiring: Decade adapter 4 auxil. units WA/WB
Adapter Photomultiplier (SEV) WP Z2–15.1

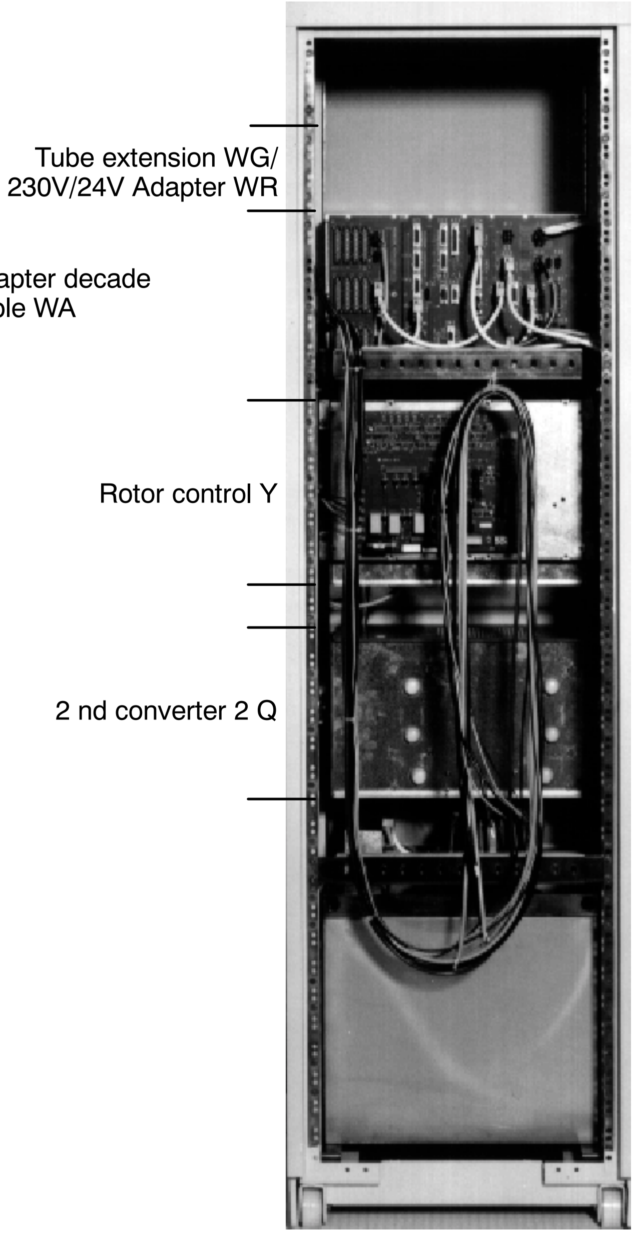
Cabinet wiring: 26V DC / 230V AC Adapter WR Z2–16

Cabinet wiring: Control desk C Z2–17

Front side

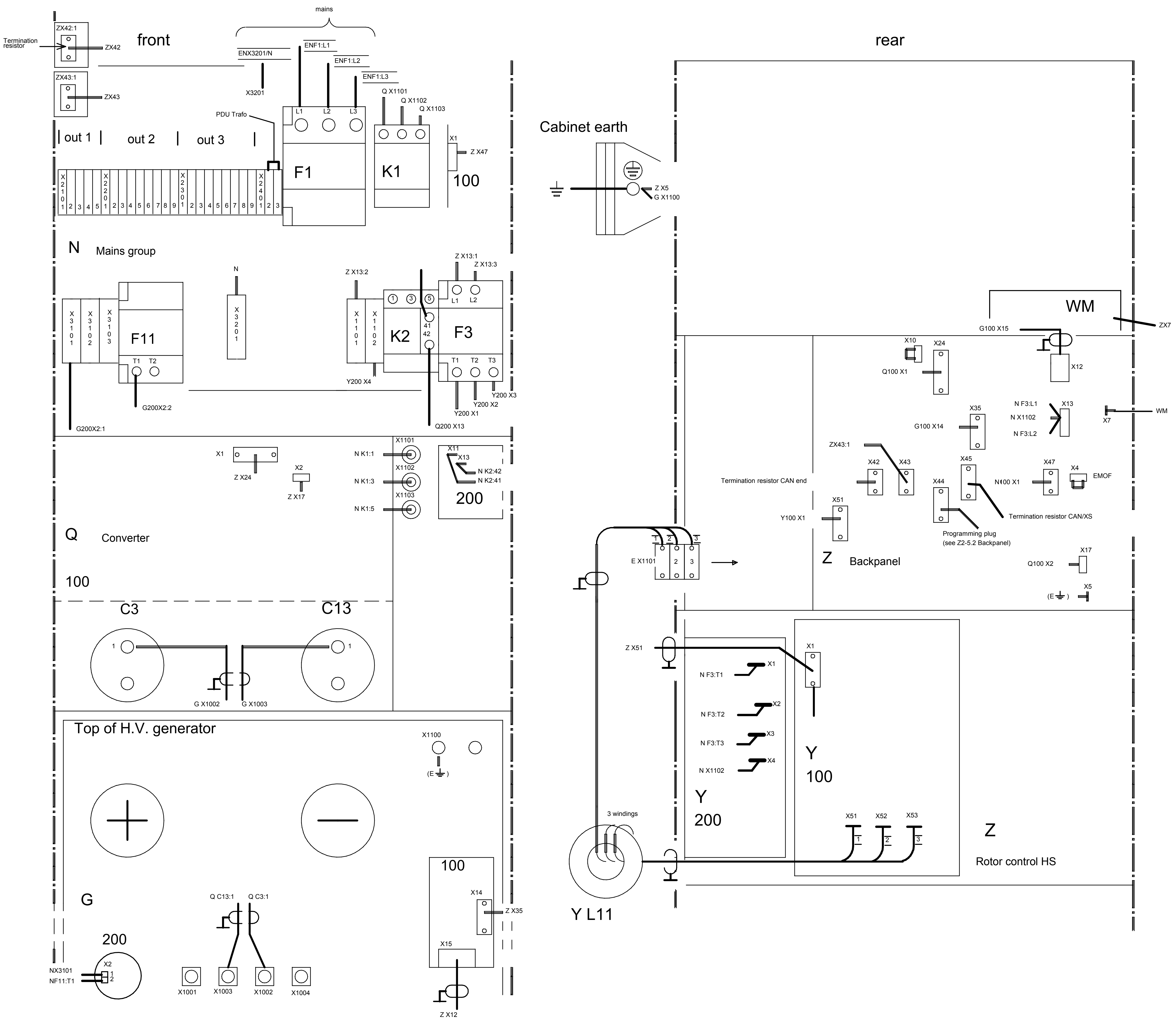


Rear side



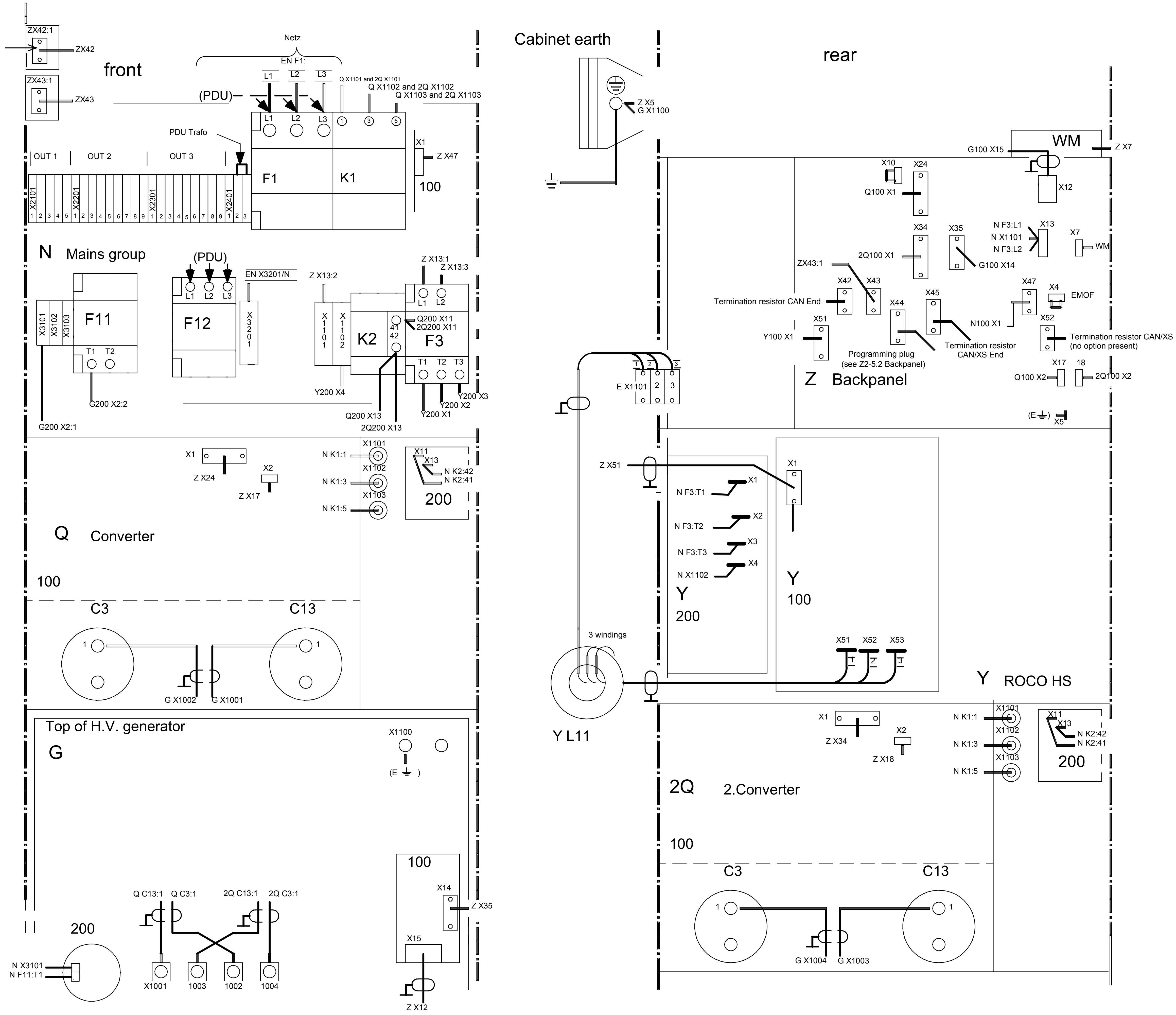
A4 99-02-99 Re
optimus_z2-1_0

Cabinet E



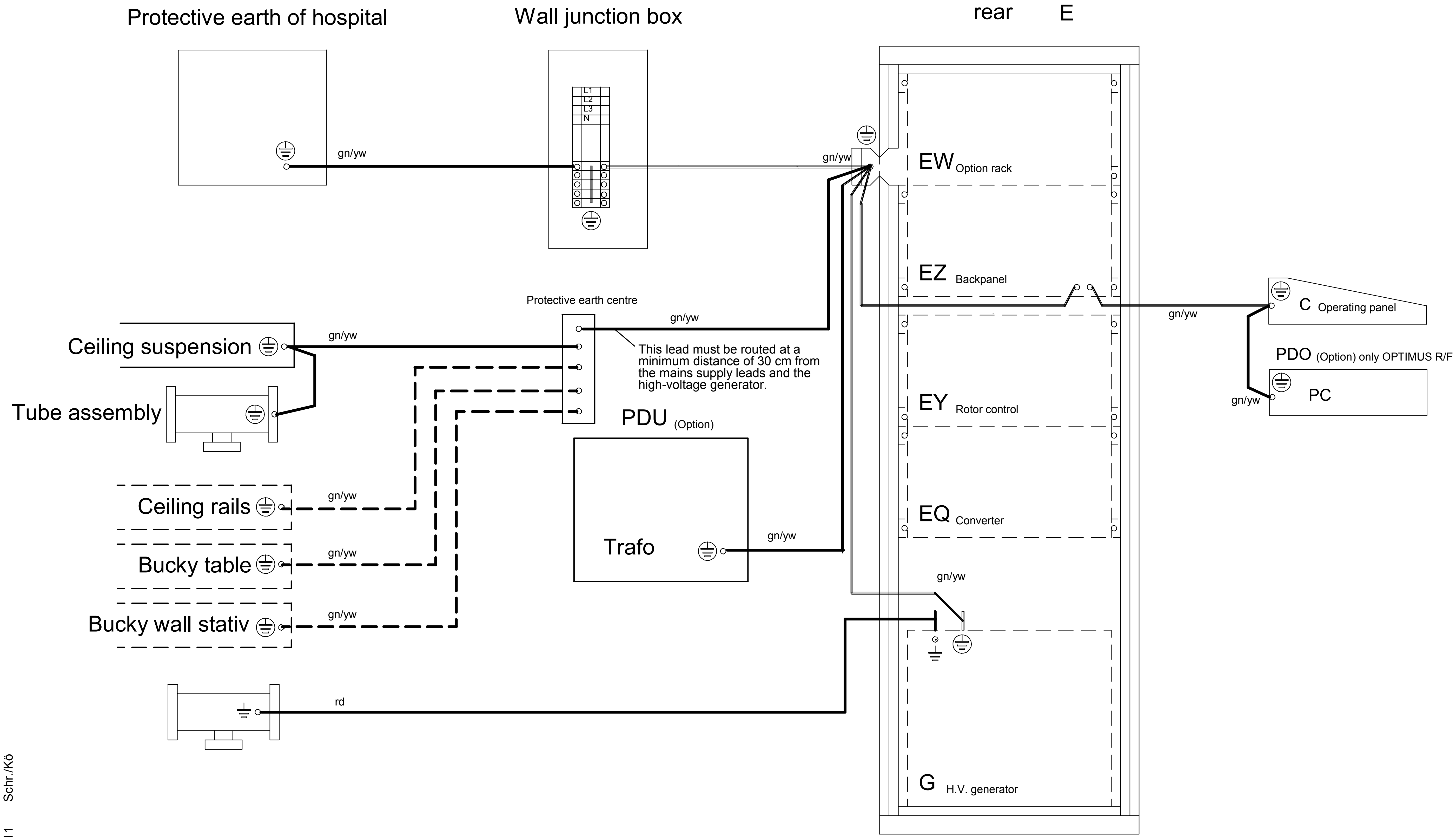
A3/A3 02-06-11 Schr./Kö

E
Cabinet wiring
50kW R/F



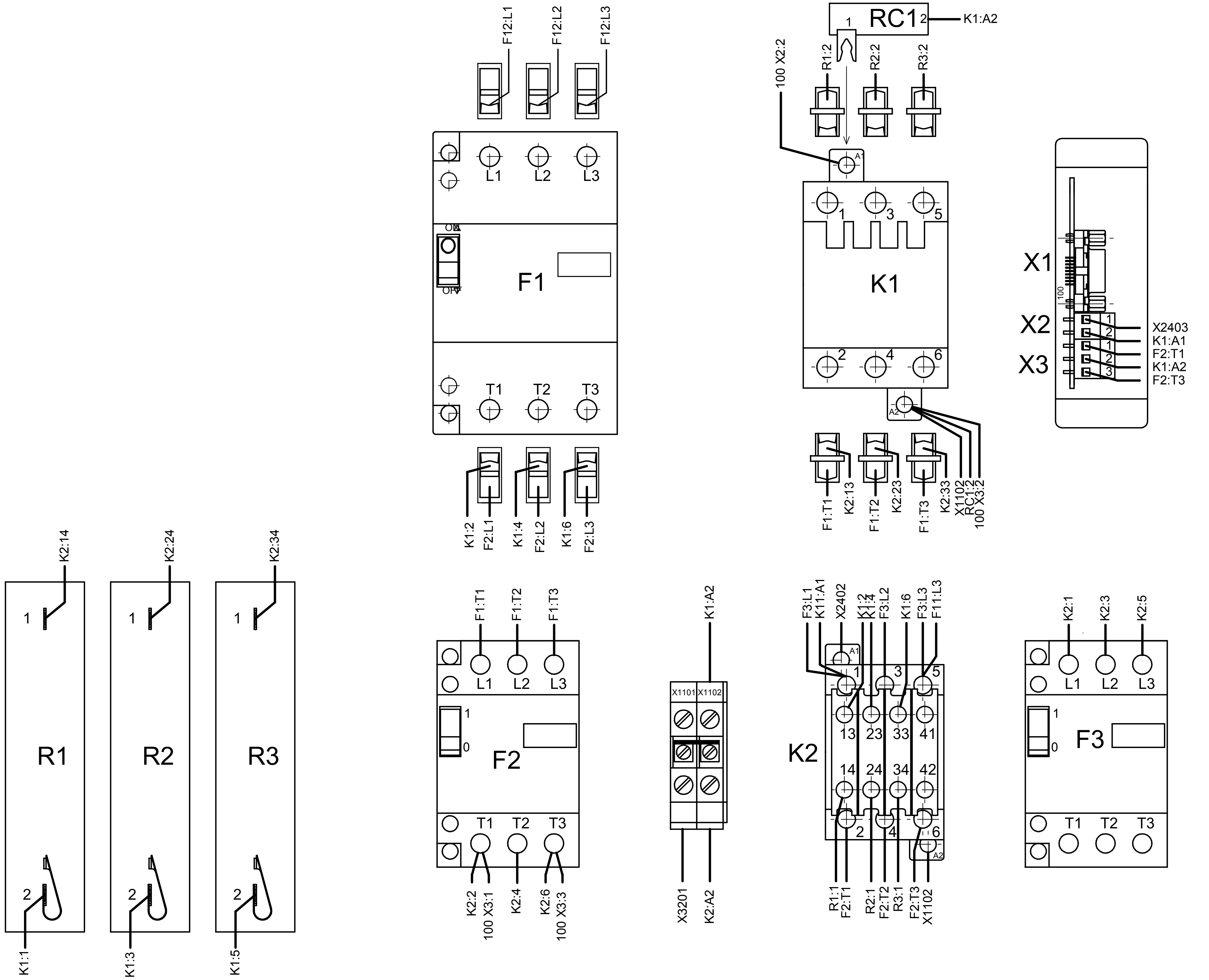
A3/A3 02-06-11 Schr./Kö

E
Cabinet wiring
65/80 kW R/F



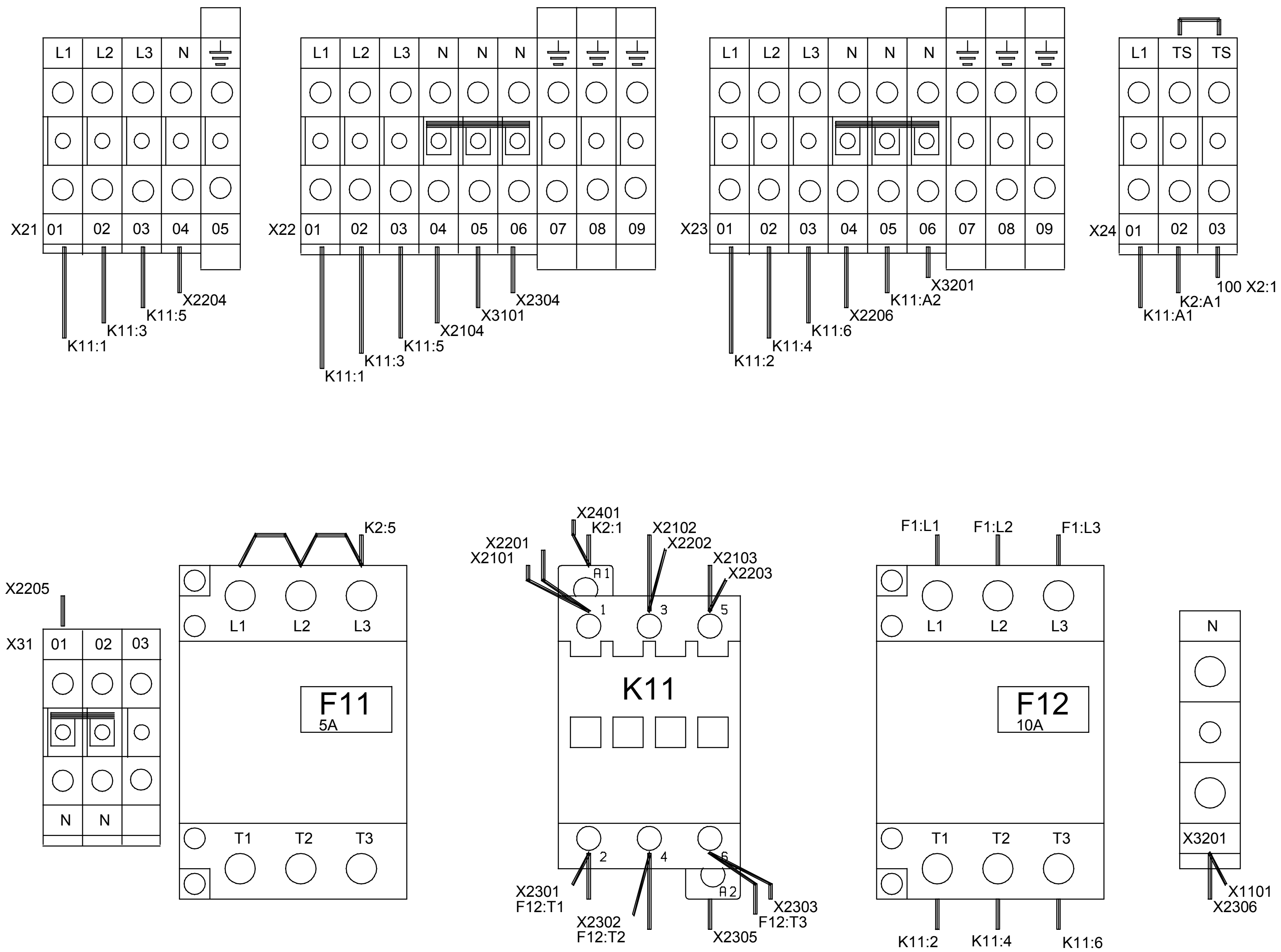
A3/A3 02-06-11 Schr./Kö

E
Earthing diagram



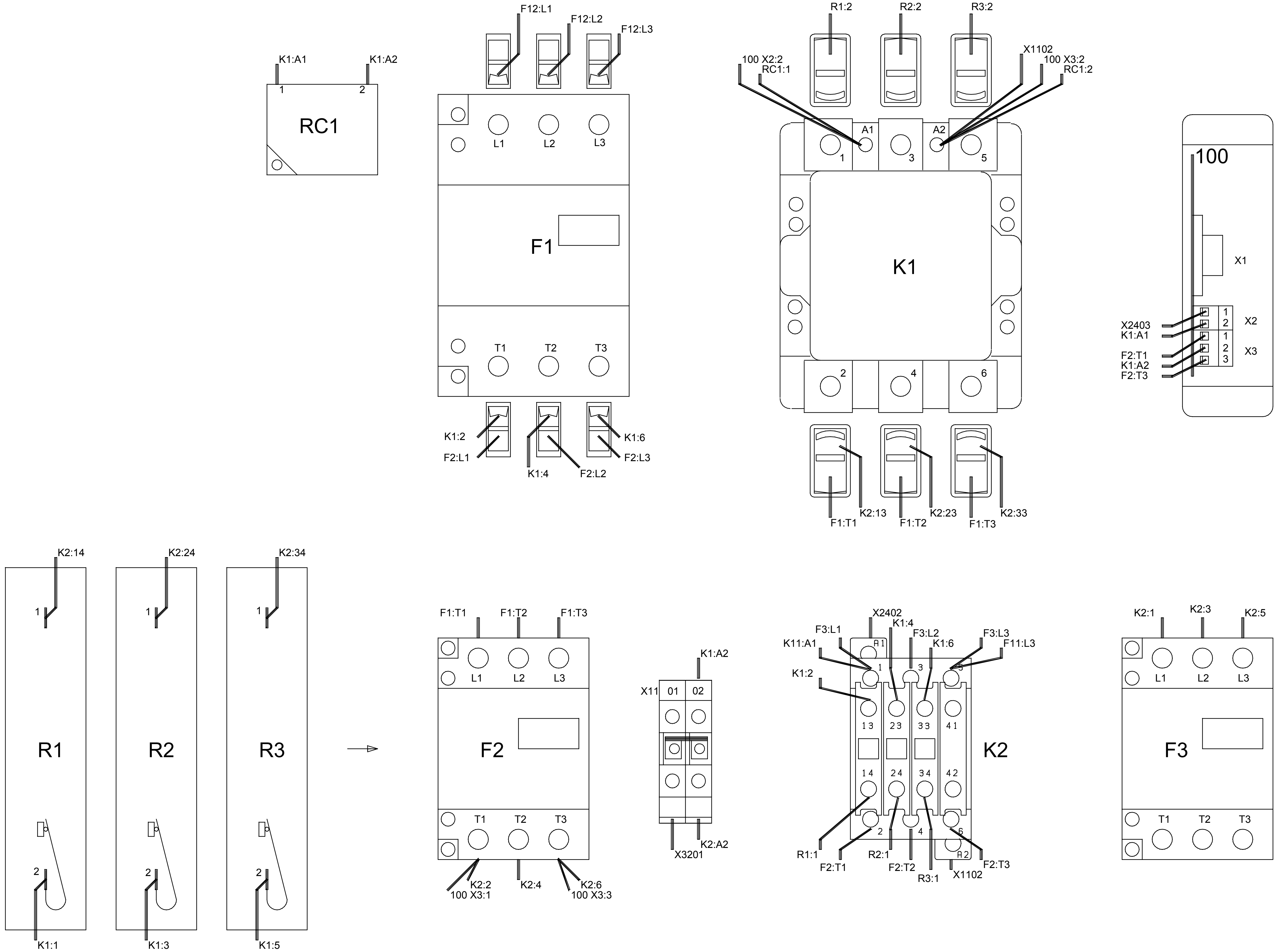
A3/A3 02-06-11 Schr./Kö

N
Power supply
50kW R/F



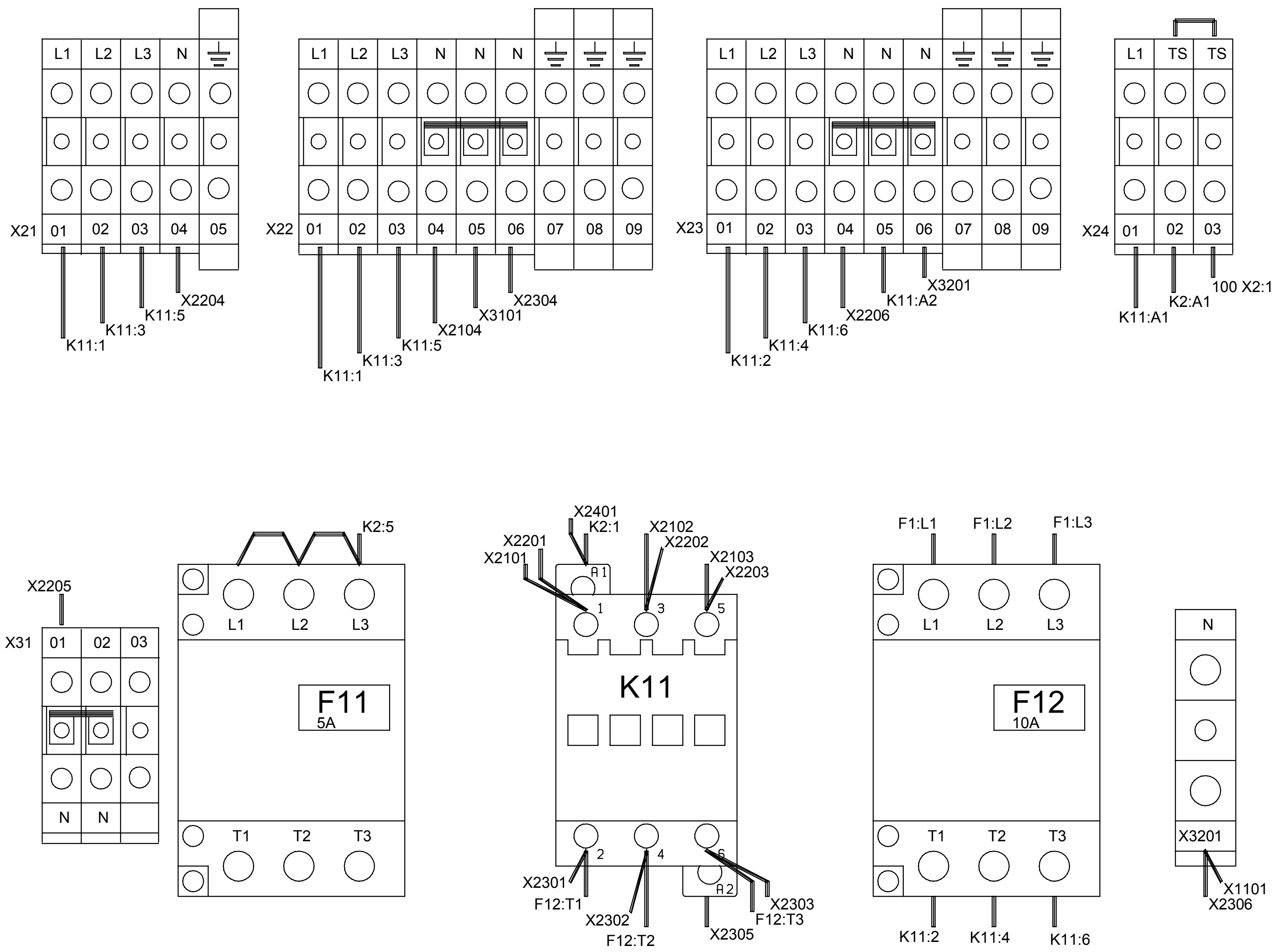
A3/A3 02-06-11 Schr./Kö

N
Power supply
50 kW R/F

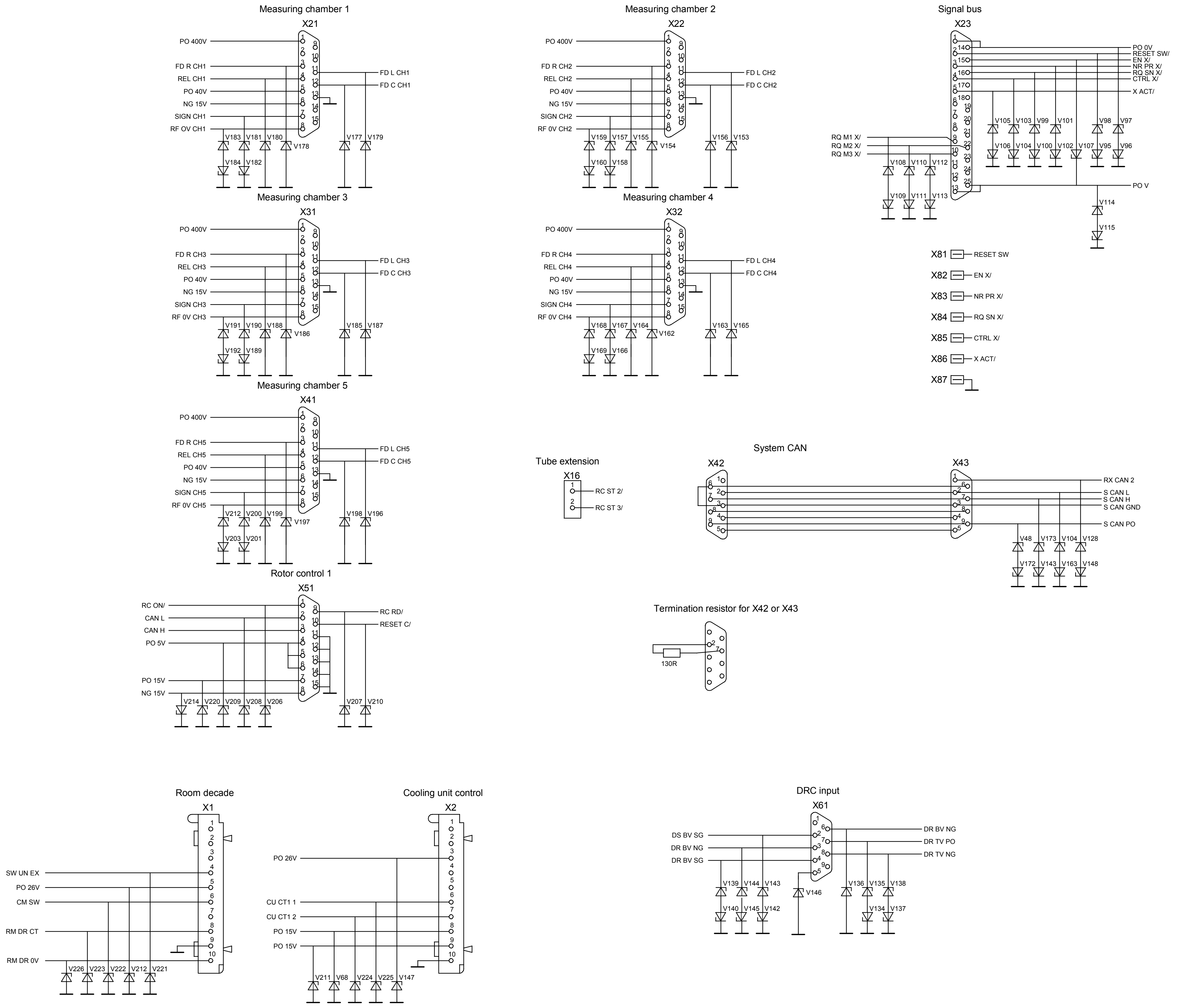


A3/A3 02-06-11 Schr./Kö

N
Power supply
65/80 kW R/F



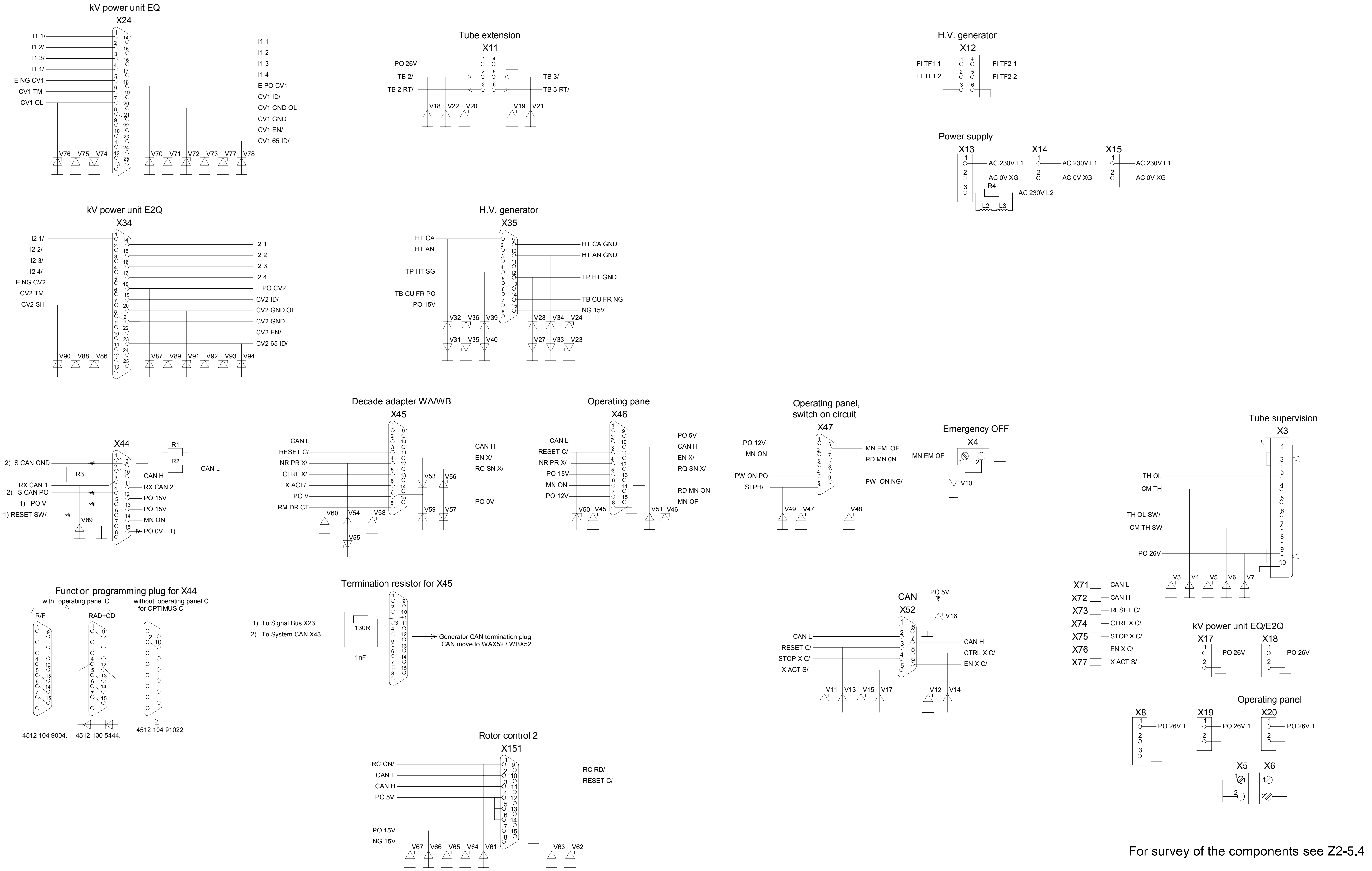
N
Power supply
65/80 kW R/F



For survey of the components see Z2-5.4

A1/A3 02-02-14 Schr.

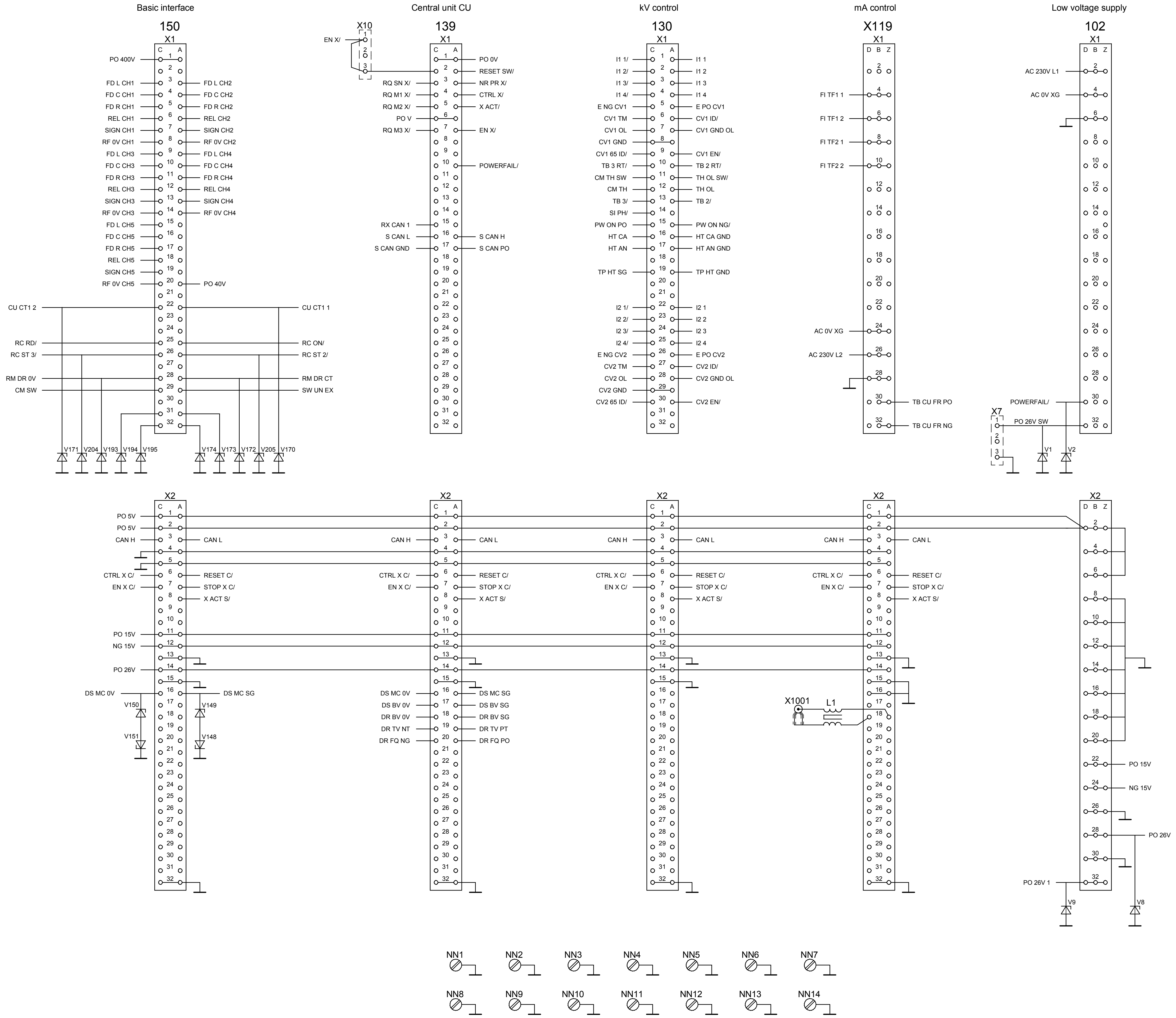
Backpanel
Basis rack-2 Z
4512 108 0936.



For survey of the components see Z2-5.4

A1/A3 02-03-19 Schr./Kö

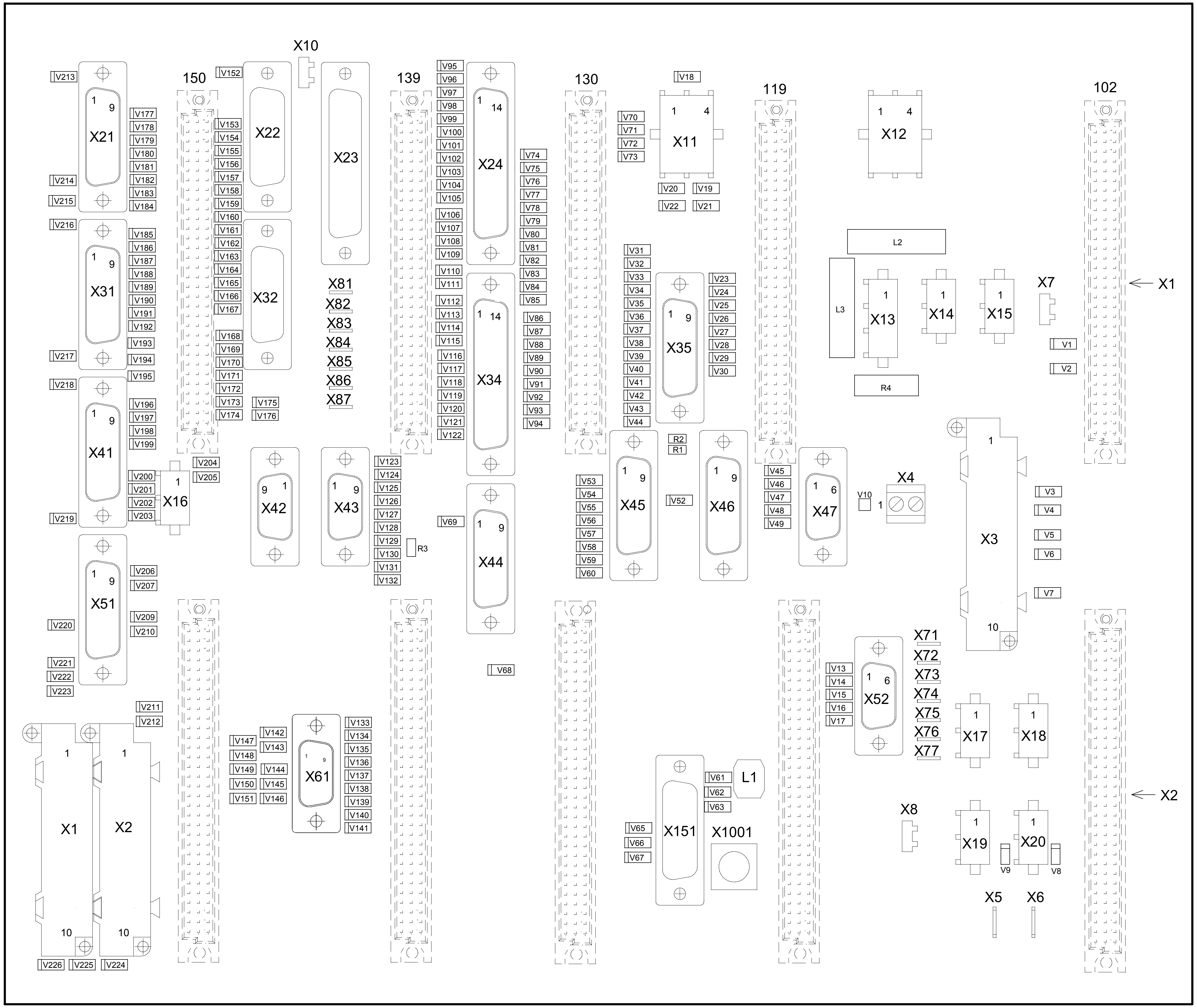
Backpanel EZ
Basis rack-2 Z
4512 108 0936.



For survey of the components see Z2-5.4

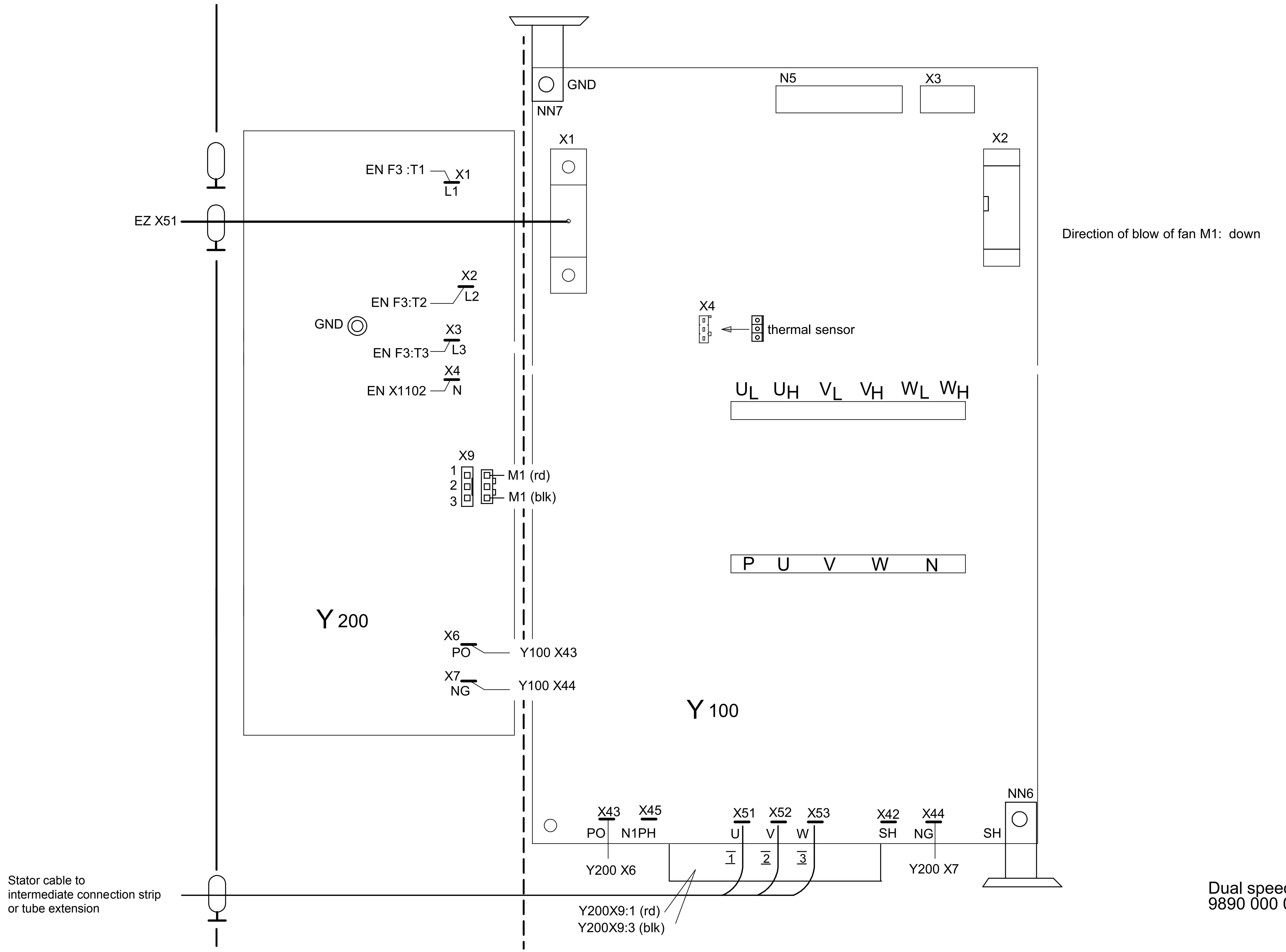
Backpanel EZ
Basis rack-2 Z
4512 108 0936.

A1/A3 02-02-14 Schr.

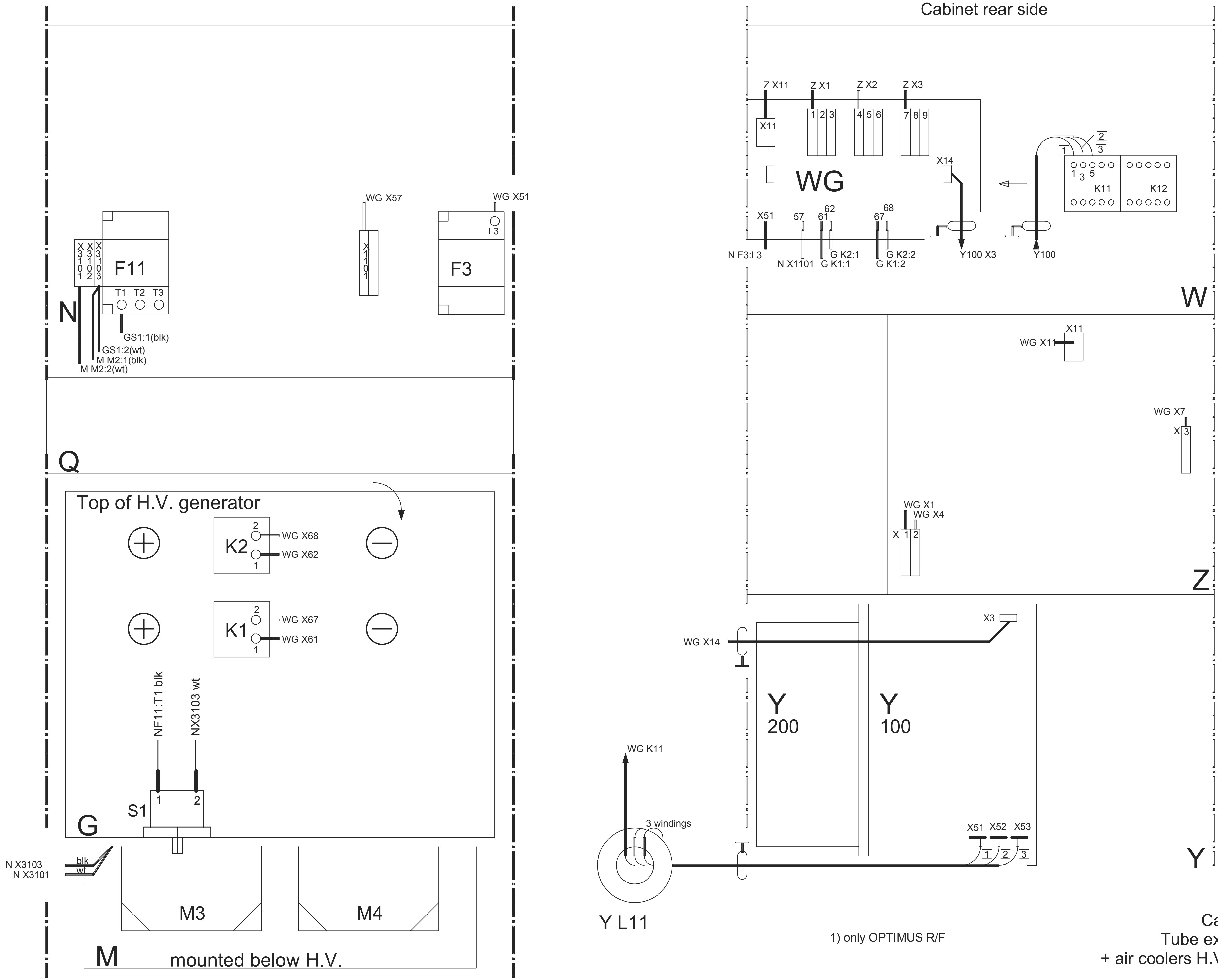


Backpanel EZ
Basis rack 2 Z
survey of components

A2/A3 02-02-14 Schr.

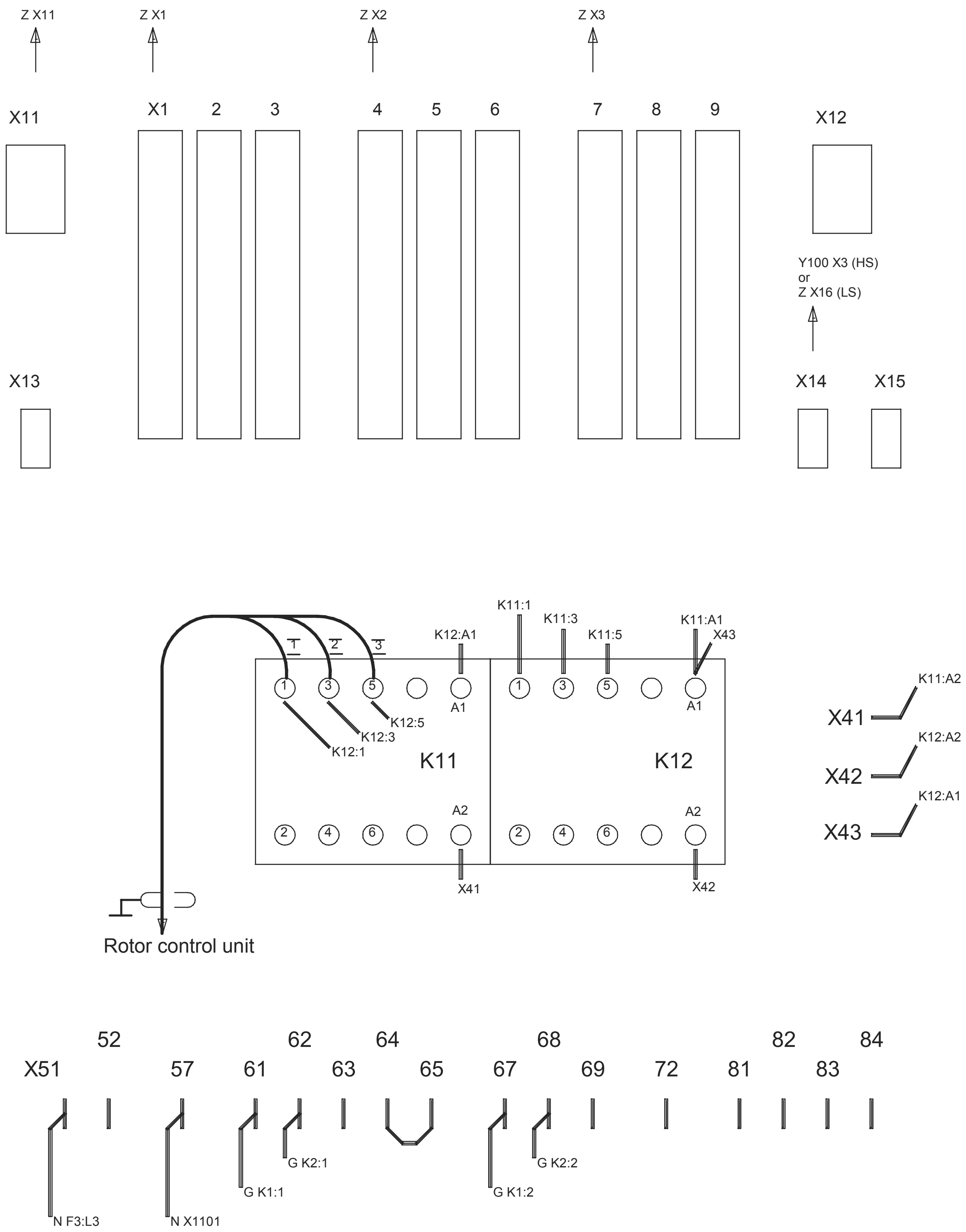


Y
Dual speed rotor control
9890 000 0268x

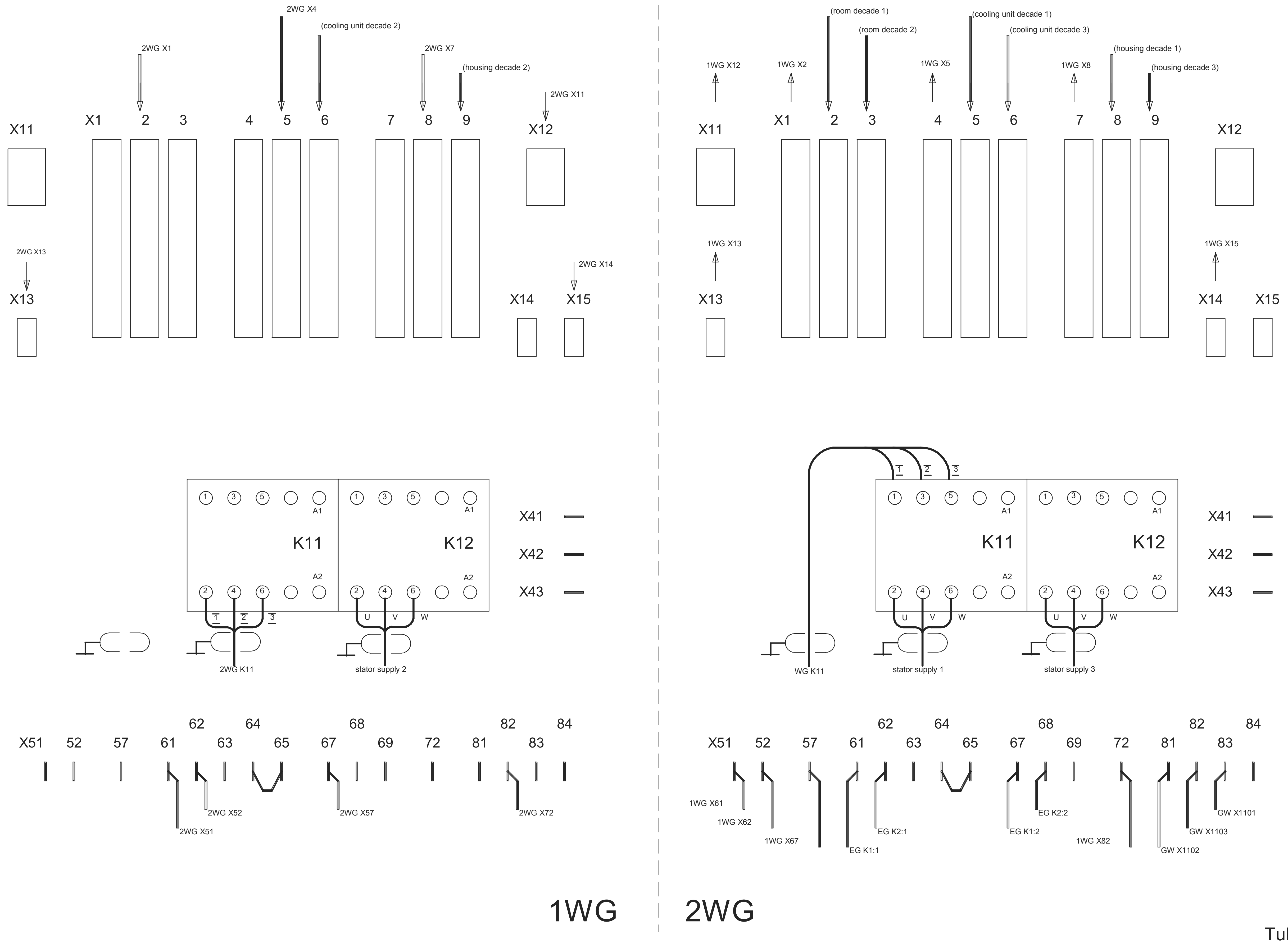


1) only OPTIMUS R/F

Cabinet wiring
Tube extension WG [1)]
+ air coolers H.V. generator



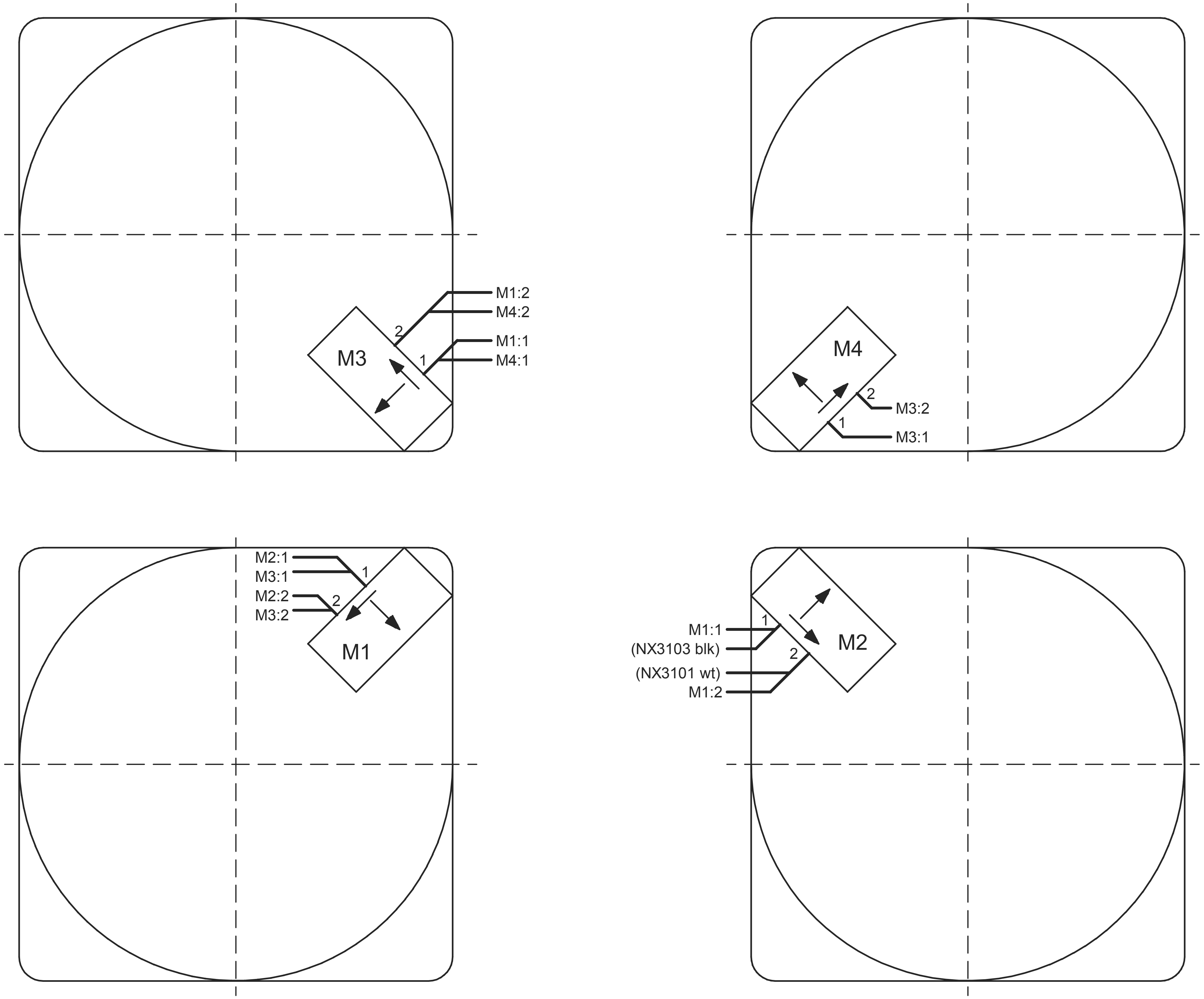
WG
Tube extension



A3/A3 96-02-28 Ost./Schr.

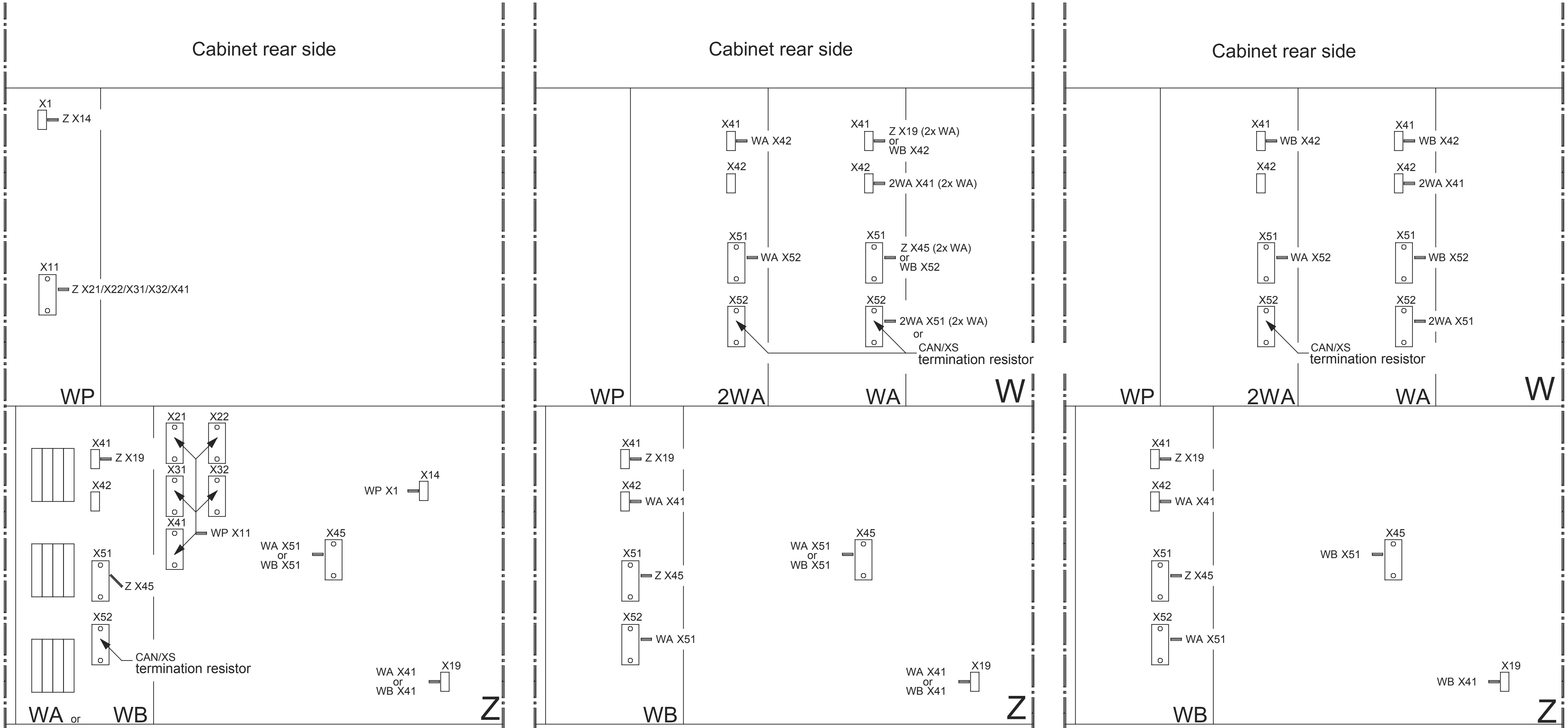
1WG/2WG
Tube extension

wiring side



M
Air coolers H.V. generator

A3/A3 97-07-07 Schr.



1 Adapter: WA or WB

always installed beside the backpanel

Adapter: WP (Photomultiplier)

always installed on the left in the option rack

2 Adapters: WA/2WA or WB/WA

both WA adapters installed in the option rack
WB adapter always installed beside the backpanel

Note: When installing a "2WA" adapter make suve that link "W1" is inserted (see also Z1-15.1).

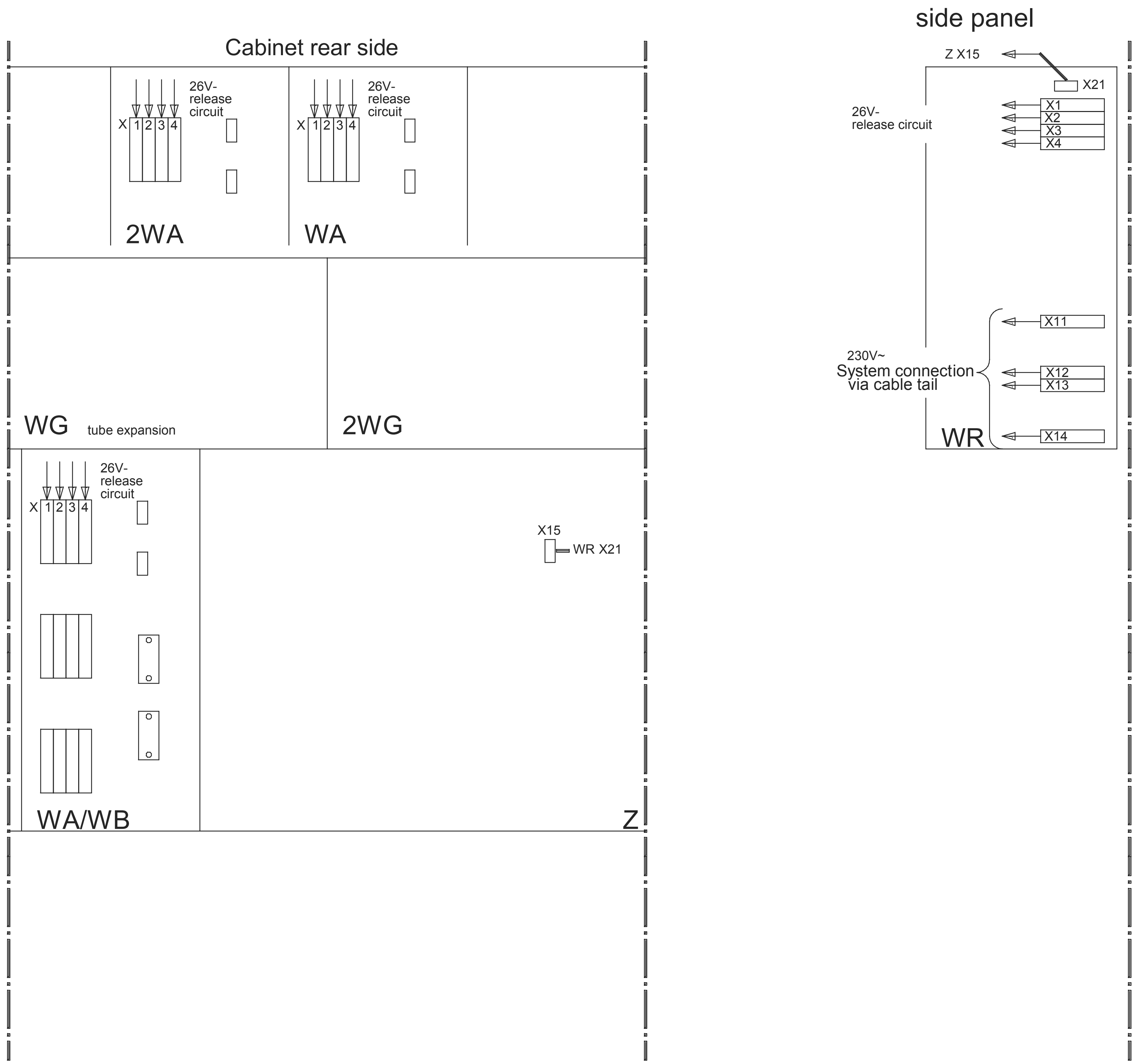
3 Adapters: WA/2WA/WB

both WA adapters installed in the option rack
WB adapter always installed beside the backpanel

CAN/XS termination resistor is alweys installed at the end of the chain!

A3/A3 97-03-12 Schr.

WA/WB/WP
Cabinet wiring:
Decade adapter 4 auxil. units
Adapter Photomultiplier (SEV)

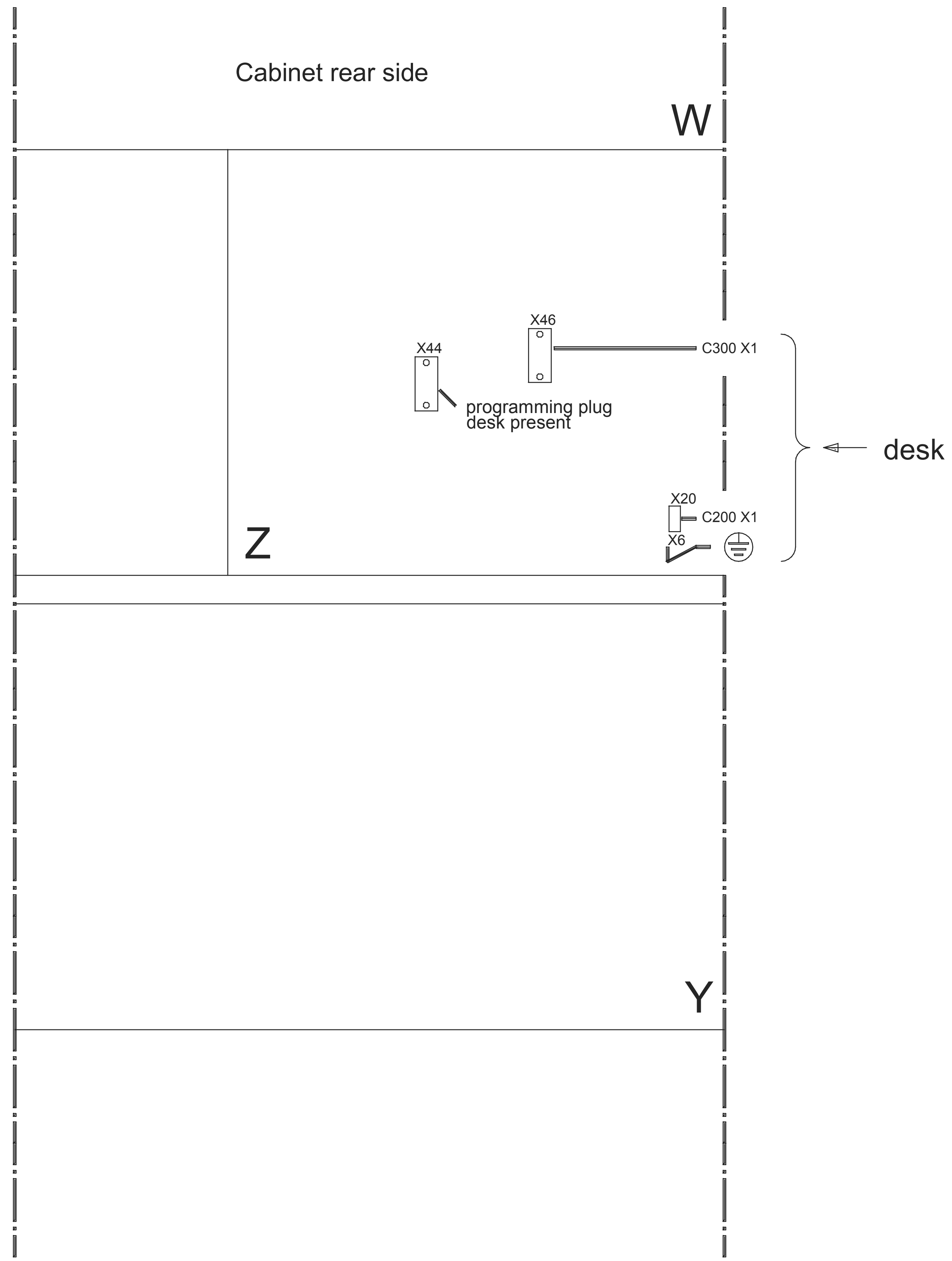


Note:

Adapter 26V-/230V is possible only in connection with decade adapter WA/WB (adapter "Old world").

A3/A3 97-03-12 Schr.

WR
Cabinet wiring
26V DC/230V AC Adapter WR



A3/A3 97-03-12 Schr.

C
Cabinet wiring
Control desk